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# Investigating antecedents to the development of competence and fulfillment among intellectually gifted adolescents: The validity of conjointly applying above-level ability and preference assessment for early educational and career planning

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Investigating antecedents to the development of competence and fulfillment among  
intellectually gifted adolescents: The validity of conjointly applying above-level ability and  
preference assessment for early educational and career planning

by

John Andrew Achter

A dissertation submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of  
DOCTOR OF PHILOSOPHY

Major: Psychology (Counseling Psychology)

Major Professor: David Lubinski

Iowa State University

Ames, Iowa

1997

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## **CHAPTER 1. GENERAL INTRODUCTION**

### **Introduction**

Recent efforts examining the educational and vocational development needs of intellectually gifted students have focused on the possibility of early intervention. There is considerable anecdotal evidence that the gifted begin to think earlier about careers than their peers. Empirical research has produced some support for this assertion, as well as the notion that tests and questionnaires devised for use with older students might be usefully applied in early adolescence with intellectually gifted individuals. Abilities and preferences, factors critical to the development of educational and vocational choice, competence, and fulfillment, enjoy long and successful histories of predicting vocational outcomes in adult populations. Although much has been uncovered in the last 25 years regarding the utility of above-level ability testing among the intellectually gifted, relatively little is known about how above-level preference assessment might also be applied to intellectually gifted persons in their early adolescent years. This dissertation reviews components of both vocational psychology and gifted student literature that relate to this question and investigates one of its important components: whether educationally and vocationally relevant values of intellectually gifted young adolescents are predictive of the types of college majors they complete almost 10 years later, above the predictive power of abilities.

### **Dissertation Organization**

This dissertation consists of three chapters. The first chapter consists of this general introduction, which includes a literature review encompassing several concepts found in vocational psychology and in literature addressing the educational and career development of

intellectually gifted persons. This integrated review culminates in a proposal for a research study addressing the validity of conjointly using above-level preference assessment and above-level ability testing with intellectually gifted adolescents to predict college majors completed 10 years later. The empirical study constitutes the second chapter, titled "The Incremental Validity of Preferences Relative to Abilities for Predicting Completed College Major Among Intellectually Gifted Adolescents." The dissertation findings are summarized in a general conclusion in Chapter 3.

### Literature Review

The literature review portion of this dissertation endeavors to weave together two somewhat disparate but complementary academic literatures, those of career choice and development found in vocational psychology and the literature involving the educational and career development of intellectually gifted individuals. The purpose of this integrated review is to provide a conceptual framework for an empirical study utilizing traditional vocational psychology variables to predict educational choices among the intellectually gifted. As recent research with intellectually gifted samples (e.g., Achter, Lubinski, & Benbow, 1996; Benbow, 1992; Benbow & Lubinski, 1996; Lubinski, Benbow & Ryan, 1995; Lubinski, Schmidt, & Benbow, 1996) has begun to demonstrate, traditional vocational psychology constructs appear to have practical utility when applied to the educational and vocational planning of gifted persons as young as early adolescence (i.e., ages 12-14). The general aim of this dissertation is to refine and extend this approach.

### Career Choice and Development: A Vocational Psychology Perspective

The topics of vocational choice, development, and decision-making enjoy a rich history in psychology (Borgen, 1991; Gelso & Fretz, 1992), dating back to the trait and factor approach anticipated by Frank Parsons (1909) near the turn of the century. Since that time, vocational psychology has remained a busy and robust discipline (Borgen, 1991).

Two approaches dominating vocational psychology research throughout its history are person-environment fit (PE fit; Rounds & Tracey, 1990) theories, focusing on the measurement and matching of personal characteristics to characteristics of work environments, and theories of career development, focusing on constructs seen as critical to the process of career decision-making, such as career maturity. In brief, PE fit theories traditionally have been invested in understanding and explaining career choices that people make, whereas developmental theories have been more absorbed in explicating the process of choosing (Chartrand & Camp, 1991; Hackett & Lent, 1992; Osipow, 1990; Rounds & Tracy, 1990). PE fit theories are exemplified today in the works of Rene Dawis and Lloyd Lofquist (Theory of Work Adjustment; 1984) and John Holland (Congruence Theory; 1985). The work of Donald Super (1980) is perhaps the best exemplar of modern developmental approaches in vocational psychology (Borgen, 1991).

#### Person-Environment Fit Models

Parsons' (1909) original trait-and-factor model of career choice, a precursor to modern-day PE fit models (Rounds & Tracey, 1990), delineated a relatively straight-forward method of matching personal characteristics, i.e., "aptitudes, abilities, interests, ambitions, resources [and] limitations" (Parsons, 1909, p. 5), to requirements of specific occupations.

Parsons used these multiple personal descriptors rather loosely by today's scientific standards, offering no operational definitions and gathering his information primarily through free-response questionnaires and personal interviews (Dawis, 1996b). This condition is not surprising given that scientific psychology at the turn of the century offered few tools to further Parsons' cause. In the words of D. G. Paterson (1938/1950): "Parsons knew what was needed, but when he went to the psychological laboratories for techniques he found that the cupboard was bare" (p. 14).

Shortly following Parsons' seminal work, and on the heels of 20 years of success by Binet in measuring intelligence (Dawis, 1996b), the field of vocational psychology welcomed the introduction of systematic, quantitative self-report instruments for measuring interests (e.g., Strong, 1927) and values (e.g., Allport & Vernon, 1931), factors seen as crucial determinants for making vocational and career decisions. Derivatives of these early instruments continue to enjoy widespread use nearly 70 years later, owing to their proven validity in predicting vocational outcomes (Arsenian, 1970; Dawis, 1991; Holland 1976; Swanson & Hansen, 1988) and to the importance of interests and values as vocational constructs (see Dawis, 1991 and Holland, 1976, for extensive reviews of preference measurement). Williamson (1939), capitalizing on the early developments of individuals like Parsons, Strong, and Allport and Vernon, offered what is credited as the first comprehensive statement incorporating trait-and-factor theory into a vocational counseling paradigm, and simultaneously introduced the systematic use of assessment measures and actuarial methods to the vocational counseling process (Rounds & Tracey, 1990). Later on, he also explicated the philosophical underpinnings of this approach (Williamson, 1965). The evolution of these

early practical, empirical, and theoretical developments are found in modern-day PE fit theories.

Even with the progress achieved earlier in the century, vocational psychology in the 1950s still lacked parsimonious theory defining the structure of relationships between personal characteristics and work environments. The Strong Vocational Interest Blank (Strong, 1927) was developed as an empirical instrument, not a theoretical one, and supplied information only at the level of empirically derived occupational scales—essentially a measure of similarity between individuals' interest profiles and the unique interest profiles of persons in various occupations. What was needed for counseling purposes was a way to link more general personal characteristics with various well-defined occupational groupings. Ann Roe (1956) took up this task and supplied such an organizational scheme in her comprehensive treatment of vocational psychology.

Roe anticipated several concepts that have been adopted and further developed by more recent vocational theorists. For instance, she organized occupations into a two-way classification system, consisting of eight interest fields, or groups (i.e., the primary focus of activity in occupations), and six responsibility/ability levels (i.e., the degree of responsibility, autonomy and skill required by jobs). This focus on a two-dimensional classification system preceded the modern day Theory of Work Adjustment (TWA; Dawis & Lofquist, 1984; Lofquist & Dawis, 1991) with its commensurate focus on both type of activity and skill level for matching persons with appropriate work environments (see next section). Drawing from the classification frameworks of her contemporaries in vocational psychology, Roe suggested the following eight interest groups: Service, Business Contact,

Organization, Technology, Outdoor, Science, General Culture (Humanities), and Arts and Entertainment. Foreshadowing Holland's (1985) spatial organization of interests, to be explained shortly, she conceptualized a circular arrangement of these groups, such that contiguous groups were more strongly related to one another than non-contiguous groups. Subsequent research has supported the fact that Roe's eight interest fields can be organized in a circular manner, although the precise circular ordering appears to differ slightly from Roe's original formulation (Tracey & Rounds, 1994).

The legacy of the contributions made by these early trait and factor theorists--from Parson's simple matching procedure, to the introduction and integration of ability and preference measurement into vocational counseling by Williamson, to initial attempts at theoretical organization of abilities and preferences by Roe--is highly evident today in modern PE fit theories. What follows are descriptions of two of the best regarded PE fit vocational theories available today.

The Theory of Work Adjustment. The Theory of Work Adjustment (TWA; Dawis & Lofquist, 1984; Lofquist & Dawis, 1991) is a modern theory that falls into the PE fit tradition. Building on Roe's two-dimensional conceptualization, TWA integrates the important dimensions of abilities and vocational preferences (interests and values) into a coherent theory about work adjustment. According to the theory, each of these dimensions is equally important and cannot be excluded in considerations about educational and career choices, inasmuch as each is conditional upon the other (Dawis, 1991).

Following TWA, person-environment correspondence is conceptualized along two dimensions: satisfactoriness and satisfaction. In order to achieve satisfactoriness, there must

be correspondence between the abilities of a person and the ability requirements, or task demands, of the environment (e.g., occupation or educational track) in which the person is operating. To reach a high level of satisfaction, on the other hand, the preferences of an individual must correspond with the types of reinforcers provided by the environment (e.g., compensation, particular working conditions). Preferences in TWA are often operationalized as interests and values (Dawis & Lofquist, 1984; Lofquist & Dawis, 1991).

The predicted outcome of the joint correspondence on TWA's two major dimensions, satisfactoriness and satisfaction, is tenure, or the amount of time spent in a particular environment. The higher the levels of satisfactoriness and satisfaction, the more the environment and the individual, respectively, will invest time in interacting with one another. Optimal adjustment, then, is predicted when personal abilities match ability requirements of the environment and personal preferences (i.e., interests and values) match the reinforcers available from the environment. While developed as a model of vocational adjustment, the constituent components of TWA are the same variables that structure critical antecedent decisions to vocational choice (Lofquist & Dawis, 1991), such as choosing various educational tracks (Lubinski, Benbow, & Sanders, 1993). TWA will guide the empirical investigation presented in Chapter 2 in this way.

Research on TWA has generally supported the major tenets of person-environment correspondence along the dimensions of satisfactoriness and satisfaction, although much of this support is drawn by inference from research not designed specifically to test components of TWA (Hackett & Lent, 1992). For example, much of the empirical support for Holland's congruence theory (see next section) can be applied to the satisfaction dimension of TWA.

due to the basic parallels in this aspect of both theories. A large body of research investigating various aspects of ability/environment correspondence provide general support for the notion of satisfactoriness. In one of the most comprehensive studies to date on this subject, Austin and Hanisch (1990) analyzed cognitive ability level, interest patterns, gender, and family socioeconomic status of over 13,000 10th grade participants in Project Talent, and found that ability level in adolescence, as measured by standardized tests, was the single best predictor of future occupational attainment. Other research confirms the salience of abilities as crucial factors in the career choice process. Wilk, Desmarais, and Sackett (1995) found that individuals gravitate toward jobs and establish tenure in positions in which there is match between cognitive ability and job requirements. In addition, the extensive meta-analytic work of Schmidt and Hunter (1981; Hunter, 1986; Schmidt, Ones, & Hunter, 1992) has illustrated that general cognitive ability is predictive of job success, as measured by criteria such as supervisor ratings and job performance. Such work has had a significant impact on the use of aptitude tests in employee selection. Reflecting on the positive relationship between cognitive ability and future job selection and performance, Austin and Hanisch (1990) commented that vocational counselors too often overlook abilities in favor of interests in working with individuals and should perhaps reconsider the utility of assessing abilities.

Other modern theories in the PE fit tradition offer frameworks for classifying persons and occupations based on the dimensions underscored by TWA. Classification systems attempt to explain and predict relationships between personal characteristics (e.g., abilities and interests) and the characteristics of environments (e.g., ability requirements and



reinforcers offered) in which people operate. Roe's (1956) system was one of the first comprehensive examples of such a system. Today, Holland's (1985) congruence theory is one at the forefront of such classification in the preference domain.

Holland's Theory. In concluding her chapter on occupational choice, Roe (1956) suggested that "it would seem that a satisfactory theory of vocational choice must depend upon a better understanding of the origin of interests" (p. 270). The most well-known person to investigate Roe's proposal is John Holland, who has been a leader in bringing PE fit theory into the modern age with his hexagonal theory of personality types and work environments (Holland, 1985), assessed on the person side through interest measurement.

At the heart of Holland's congruence theory is his six-factor categorization of personality and work environments. RIASEC is the acronym for Holland's hexagonal system of personality types (brief descriptions are given in parentheses): Realistic (interests in working with things and gadgets, working in the outdoors, need for structure), Investigative (scientific interests, especially mathematics and the physical sciences, independent work), Artistic (interests in creative expression in writing and the arts, preference for little structure), Social (people interests, drawn toward the helping professions), Enterprising (prefer leadership roles aimed at achieving economic or political objectives), and Conventional (prefer well-structured environments and chains of command, such as those found in office practices, tend to be followers not leaders). Taking his lead from Roe (1956), Holland's theory asserts that these basic interest dimensions can be arranged in a circular order (represented by a hexagon), such that contiguous themes are more similar than non-contiguous themes.

At its most basic level, Holland's (1985) concept of congruence asserts that individuals with particular personality characteristics will more likely seek work environments that value and reinforce these characteristics, and will be most satisfied if they choose such environments. As mentioned in the previous section, Holland's congruence notion parallels the TWA concept of correspondence, but exclusively addresses the preference dimension. Several commentators in the field have noted the overlap of these constructs (Borgen, 1991; Dawis, 1996a; Osipow, 1990). Volumes of research have consistently shown that individuals' RIASEC themes, as measured by instruments such as the Strong Interest Inventory (Strong; Harmon, Hansen, Borgen, & Hammer, 1994), are predictive both of vocational choice and satisfaction (Hackett & Lent, 1992). In addition, the circular organization of interests proposed by Holland has generally stood up to empirical test with adult populations both in the United States (Rounds & Tracey, 1993; Tracey & Rounds, 1993) and several foreign countries (Rounds & Tracey, 1996), and with intellectually gifted samples in the U.S. (Lubinski et al., 1995; Schmidt, Lubinski, & Benbow, 1997).

The marriage of Holland's theory with the Strong-Campbell Interest Inventory by Campbell and Holland (1972) has been viewed by commentators in the field (e.g., Borgen, 1991; Donnay, in press) as a critical milestone in the history of vocational psychology. By merging a comprehensive PE fit theory with a widely utilized interest assessment device in vocational psychology, the coalition provided, for the first time, theory-based interpretive information to the empirically-based Strong (for a 70-year review of the Strong, see Donnay, in press). Due in no small part to its merger with instruments such as the Strong and to the simplicity and robust nature of the constructs Holland chose to examine, Holland's theory has

stimulated the most productive segment of vocational psychology research for over 20 years (Borgen, 1991; Spokane, 1996).

Holland's RIASEC system represents the state of the art in vocational preference/personality classification. In efforts to further discern and simplify Holland's system, a few theorists have attempted to capture the essence of Holland's six interest themes with a smaller number of underlying dimensions. For example, Prediger's (1982) model imposed two bipolar dimensions--data/ideas and things/people--onto Holland's hexagon to help parsimoniously explain the link between vocational preferences and occupations. The bipolar data/ideas dimension is defined by drawing a straight line bisecting the distances between the C and E themes and the I and A themes, respectively, on the hexagon. The things/people dimension, on the other hand, is created by drawing a straight line directly through the R and S themes. In contrast, Hogan (1983) offered two alternative dimensions--conformity and sociability--to capture the personality structure underlying the hexagon (Borgen & Harmon, 1996). In Hogan's scheme, the conformity continuum connects the C and A themes and the sociability continuum bisects the distances between the R and I themes and the S and E themes, respectively, on the hexagon. In a meta-analysis of studies investigating these two alternative descriptions of Holland's six themes, Rounds and Tracey (1993) concluded that both of these formulations appear to be equally plausible and contribute to understanding two different aspects (i.e., vocational preference structure vs. personality structure) of Holland's theory.

Other Contributions to Vocational Classification. Other conceptualizations of the relationships among vocational constructs have also been suggested. One of the most concise

theoretical statements offered to organize categories of academic/intellectual pursuits was supplied by C. P. Snow's (1959) demarcation of "two cultures," humanistic and scientific. Snow, reflecting on his experience as both a writer and scientist, observed that there seem to exist in academic settings two distinct intellectual cultures, broadly labeled the humanistic and the scientific, which are clearly different in the ways they view the world and approach and solve problems. In their extreme manifestations--i.e., when the attributes that distinguish one group from the other become more distinct--these two cultures are so psychologically dissimilar that communication between the two becomes strained, even though collaboration and cooperation might frequently produce beneficial outcomes stemming from mutual goals (Snow, 1959). Research into abilities and preferences has supplied a refined understanding of the differences between these two cultures.

In the ability arena, the two cultures parallel Vernon's (1961) mapping of abilities into the two content domains of verbal-educational (corresponding to the Humanities) and mechanical-spatial (corresponding to the sciences) (Humphreys, Lubinski, & Yao, 1993). As presented in the earlier discussion of TWA, persons tend to gravitate toward the broad domain that best matches their abilities (Wilk et al., 1995) and their preferences. In the preference domain, Borgen (1972), using a classificatory system similar to Snow's dichotomy, achieved 72.5% accuracy in predicting science vs. non-science career choices from the basic interest scales of the Strong, in a group of National Merit Scholar students 3 years after initial assessment. Interestingly, the psychological reality of Snow's two cultures has also received empirical support from both experimental (Kimble, 1984) and differential (Humphreys et al., 1993) psychological inquiry.

More recently, Ackerman (1996) and colleagues (Ackerman & Heggestad, 1997) have published studies with adult populations that point to an integrative understanding of relationships between intelligence, personality, and interests--based on well-established definitions of these constructs--and reveal parallels to Snow's observations. Among other things, the analyses showed robust relationships between the combinations of Spatial and Math abilities with Holland's Realistic and Investigative Interests, and between Verbal abilities with Artistic interests (primarily) and Investigative interests (secondarily). These ability/interest combinations were also shown to be related to knowledge in areas strikingly similar to Snow's two cultures. Specifically, Ackerman (1996) reported that the Verbal/Artistic combination of abilities and interests was highly correlated with self-reported knowledge in the humanities and arts, and that the Math-Spatial/Investigative combination was highly correlated with self-reported knowledge in math, physical sciences, and technology. Interestingly, Ackerman and Heggestad (1997) reported that the strongest relationships to specific intellectual abilities were found with Realistic, Investigative and Artistic interests (those most strongly related to the two cultures), whereas Social, Enterprising, and Conventional interest domains had weaker relationships with specific intellectual ability domains.

Because of its simplicity and the relatively well-understood relationships between the two cultures and both ability and preference dimensions, Snow's dichotomous classification of intellectual/academic fields will be used to categorize educational fields in the empirical study presented in Chapter 2 of this dissertation.

It is evident from this brief review that the PE fit approach to vocational psychology continues to be a major force and to make critical contributions to the field. Other theories exist, however, that approach vocational psychology from somewhat different perspectives. One of the major classes of alternative approaches in vocational psychology are developmental models.

### Developmental Models

Developmental theories in vocational psychology emerged as a reaction to perceived shortcomings of trait and factor, or PE fit, models. In their historical review of career development theories, Phillips and Paziienza (1988) traced the origin of developmental theories in vocational psychology to the early 1950's and a model presented by Ginzberg, Ginsburg, Axelrad, and Herma (1951). The appearance of this theory represented a culmination and integration of several years of loosely-connected, developmentally-oriented reactions to the trait and factor model that previously dominated vocational psychology. The trait and factor approach was regarded by its developmental critics as treating vocational choice as a discrete event or a point-in-time phenomenon, devoid of attention to antecedents, consequences, or the process of decision-making (Phillips & Paziienza, 1988). The Ginzberg et al. (1951) theory fueled optimism that developmental theories would be able offer insight into these latter, and until that time neglected, variables.

Shortly after the Ginzberg et al. conceptualization, Super (1953) offered a critique of the new developmental theory and proffered what has become the most widely known career development model in vocational psychology, introducing the term "vocational development" to the literature (Phillips & Paziienza, 1988). Super believed that the concept of

"occupational choice," emphasized by proponents of trait and factor theory, was too limiting and that there was much more to the process of choice than the simple matching of persons and environments, as well as much more to study about people both before and after occupational choices are made. These assertions clearly distinguished Super from the trait and factor theorists of the day.

Super's Theory. The major tenets of Super's (1953) developmental formulation center around his five vocational life stages, each involving characteristic activities and tasks to be accomplished (approximate ages and descriptions of stage-specific tasks are located in parentheses; excerpted from Super, Savickas, & Super, 1996): Growth (ages 4-13; becoming concerned about future, increasing sense of personal control, convincing self to achieve at school and work, acquiring good work habits), Exploration (ages 14-24; crystallizing, specifying, and implementing an occupational choice), Establishment (ages 25-44; stabilizing, consolidating, and advancing occupational position), Maintenance (ages 45-65; holding on, keeping up, and innovating), Decline or Disengagement (ages over 65; deceleration, retirement planning, retirement living).

Other constructs that emerged out of Super's early work include "career maturity" and "vocational self-concept." Of these, career or vocational maturity has received the most attention. Super (1955) first defined vocational maturity as "the place reached on the continuum of vocational development from exploration to decline" (p. 153), following his stages of career development. Later, Super and Overstreet (1960) simplified this definition to describe career maturity, essentially, as planfulness. In a still more recent formulation, career maturity was defined by Super (1990) as readiness to cope with developmental tasks

currently facing an individual. Finally, Super et al. (1996) defined career maturity in normative terms, first from a social or societal perspective, as the developmental tasks presently being encountered by an individual compared to the tasks expected based on the individual's age, and second from a psychological perspective, as the cognitive and affective resources possessed by an individual compared to the resources needed to cope with specific developmental tasks.

Still more definitions of career maturity have been offered by other developmental theorists, most notably Crites (1978), a situation that has produced a confusion in terminology and a barrier to career development research (Betz, 1988, 1992). Despite this circumstance, career maturity has been operationalized in several instruments that have enjoyed widespread use in both research and applied settings. As operationalized by Super and colleagues in the popular Career Development Inventory (CDI; Super, Thompson, Lindeman, Jordaan, & Myers, 1979), career maturity includes indicators of career interest, level of involvement in the decision-making process, and three types of knowledge: knowledge of the decision making process, of resources to assist in making decisions, and of specific occupations.

Another of Super's popular constructs, the vocational self-concept, is defined as an individual's subjective understanding of his or her abilities, interests, values, and choices and how these constructs create vocational purpose (Super et al., 1996). In essence, Super discusses the self-concept in relation to vocational choice and conceptualizes choice as the implementation of the self-concept into an occupation or career. This conceptualization admittedly parallels the PE fit notions of correspondence and congruence.



Empirical investigations employing Super's concepts have been widespread, but frequently have not explicitly tested his theoretical propositions (Hackett & Lent, 1992). Often the theory is not referenced as a source of hypotheses, but rather in a post hoc fashion to help explain results (Super et al., 1996). This situation has been attributed to the fact that, by Super's (1990) own admission, his theory is "segmental" in nature, "a loosely unified set of theories dealing with specific aspects of career development" (p. 199). This critique has been applied to the theory since its inception, when early observers like Roe (1956) noted that "[Super's theory] points out many factors that must be considered as determinants of occupational behavior, but without offering an adequate organization of them" (p. 269). Despite this condition, reviewers (e.g., Hackett & Lent, 1992; Osipow & Fitzgerald, 1996) have concluded that the few direct tests, combined with indirect evidence from studies of related concepts, generally support Super's constructs of career stages and the role of the self-concept in career development. Extensively researched, but not as well supported, is Super's concept of vocational maturity. While this research is still considered in its infancy by some (Betz, 1992), the lack of definitional clarity and agreement across theorists has led to criticisms from researchers trying to study vocational maturity instruments (Betz, 1988, 1992; Jepsen & Prediger, 1981). Notwithstanding this circumstance, career maturity remains a central concept in vocational developmental theory (Super et al., 1996).

Super's model has expanded over the years while retaining the developmental stages as a stable theoretical base. In his most recent published work, Super (1980, 1990; Super et al., 1996) expanded his developmental ideas into what he termed "a life-span, life-space

approach to career development," incorporating new concepts such as "life roles" and "role salience." Little empirical evaluation of this work has yet emerged, however.

### Convergence of Vocational Theories

In many ways, time has witnessed the gradual convergence of PE fit, developmental, and other vocational theories (Osipow, 1990; Borgen, 1991). For instance, Holland's congruence theory, a modern PE fit theory, has expanded to explain the developmental rise of attitudes, and, as previously noted, Super's developmental theory addresses the topic of career choice, a PE fit construct, in discussions of implementing the self-concept in the world of work.

Noting the existence of these commonalities and intrigued by the possibility of greater parsimony and explanatory power for a wider range of vocational and career constructs, several researchers and practitioners in vocational psychology have developed an integrationist attitude, spurring a recent conference devoted entirely to the topic of convergence among career theories (Savickas & Lent, 1994). The goal of the convergence conference, as stated by the editors of the book of conference papers, was "to account for relationships among seemingly diverse constructs, to promote more comprehensive theories, and to reduce redundancy and promote parsimony" (Lent & Savickas, 1994, p. 266). Contributions to the conference and book came from some of the foremost theorists in vocational psychology, including Rene Dawis, John Holland, John Krumboltz, and Donald Super.

The goal of convergence among career theories received only a luke-warm reception from these accomplished vocational scholars, all of whom have devoted much of their

professional lives to developing and testing their own unique vocational theories. The general sentiment among them was that the goal of convergence is ill-advised, or at least overly optimistic at the present time. They asserted that while commonalities exist across theories, they are primarily on a superficial level, and each theory contains important differences in the ways even similar constructs are conceptualized and defined. This cautionary view was expressed most strongly by Holland (1994), who suggested that the field of vocational psychology would benefit more from the improvement of existing theories than from any attempts at theory convergence. One of the principal worries mentioned by these authors was that convergence attempts could result in adopting a "cafeteria" approach in vocational psychology, whereby unrelated concepts are inappropriately merged in the interest of integration, potentially resulting in a meaningless hodgepodge of theoretical concepts. Collectively, this group agreed that convergence itself should not be pursued as a focus of research, but instead left as a potential outcome of naturally occurring theory development, testing, and revision (Lent & Savickas, 1994).

By comparison to the voices of these major scholars, the scientist-practitioners who contributed to the Savickas and Lent (1994) volume collectively were more optimistic about convergence efforts among vocational theories. Presenting chapters on theory convergence from the perspectives of each major theoretical framework represented by the primary contributors mentioned above, this group of research-clinicians presented a more positive outlook of convergence possibilities pursued through careful research. They conceded, however, that at present convergence exists only at very general level.

Unfortunately for these more sanguine individuals, the convergence conference resulted in no unified statement either about the merits of convergence among vocational theories or about the framework from which such efforts should proceed, leaving the future of convergence efforts up in the air. At present, it appears that the integrationist attitude remains popular in some vocational psychology circles, but that the jury is still out on both the merits of convergence and the direction (if any) of future research efforts (Savickas & Lent, 1994).

#### Summary of PE fit and Developmental Theories

PE fit and developmental theories continue to dominate the field of vocational psychology. The more mature of the two groups, PE fit, has the best track record in terms of testability of its constructs and predictive utility for real-world outcomes (Hackett & Lent, 1992; Rounds & Tracey, 1990), meeting both the scientific and practical criteria of the individual differences tradition from which PE fit theories emanate (Lubinski, 1996). Developmental theories, on the other hand, emerged with the promise of addressing some of the shortcomings of PE fit theories. While young by comparison to PE fit models, developmental models have enjoyed widespread use in applied settings and contain great heuristic value, but their constructs do not yet share the measurement sophistication and predictive validity enjoyed by PE fit constructs and measures. Efforts at integrating PE fit, developmental, and other vocational theories into broader, more comprehensive models are a recent development and await further maturation and examination.

### Educational and Career Development in the Intellectually Gifted

The first systematic, longitudinal effort in studying the lives of gifted students emerged parallel to a burgeoning time period in vocational psychology. The Terman et al. (1925) longitudinal studies of intellectually gifted individuals (participant selection based on teacher nominations coupled with individual IQ assessments) began in the 1920's, shortly before the creation of the Strong Vocational Interest Blank (Strong, 1927), the most widely used questionnaire of vocational interests. Among the many topics intriguing to Terman and his colleagues were the educational paths and career choices of the extremely bright individuals in their study. Using the Strong Vocational Interest Blank, Terman (1954) noted that childhood interests among the gifted discriminated several years later between scientists and non-scientists, and that the Strong could usefully differentiate between interests in intellectually gifted populations. Given that gifted individuals are advanced in one or more cognitive domains (e.g., mathematical, verbal, or spatial ability), some authors have suggested that they advance more rapidly in their career decision-making and vocational preference development as well. The following sections explore these notions in more depth.

#### Precocious Career Development?

The possibility has been suggested that gifted adolescents begin at an earlier age to think about careers (Kerr & Erb, 1991; Milne, 1979). If a 7th grader is capable of reasoning mathematically or verbally at or above the 12th grade level, maybe he or she is also thinking ahead to college majors in math/science or philosophy/law, or even to a career in one of these domains. Empirical evidence exists to suggest that advanced educational and career thinking is present in many gifted youth, most likely as an outgrowth of their advanced cognitive

development (Silverman, 1993). In fact, Willings (1986) suggested that most gifted students begin thinking seriously about their work futures by the age of nine. Typically, however, structured career search programs in schools are not implemented until the senior high years, when they may be developmentally mis-timed for gifted students (Kerr, 1981; Willings, 1986).

Career Maturity Among Gifted Adolescents. To study more systematically the notion that gifted adolescents begin to plan their future careers earlier than normal ability peers, Kelly and his colleagues (Kelly, 1992; Kelly and Cobb, 1991; Kelly & Colangelo, 1990) looked at various career development characteristics of gifted adolescents by administering measures of career maturity gleaned from developmental theories in vocational psychology.

In their first study, Kelly and Colangelo (1990) compared gifted, regular curriculum, and special-learning-needs students on their level of career maturity, as operationalized in the Career Maturity Attitude Scale (Crites, 1978). Career maturity included the elements of career decision making knowledge, extent of career exploration involvement, and certainty of career choice. Findings indicated clear differences on the career maturity measure between the three groups, with the gifted group scoring significantly higher on career maturity than normal curriculum students and normal curriculum students scoring higher than special learning needs students. These results supported the notion of precocity in the domain of career development.

In a second study, Kelly and Cobb (1991) investigated two factors found to be common across various career development assessment instruments: cognitive resources (knowledge about the world of work and factors influencing career decisions) and

extensiveness of career-planning involvement. Using Super's Career Development Inventory (CDI; Super et al., 1979) to measure these two factors, the authors compared scores of gifted students (ages 11-14) to the 9th grade norm-group on the CDI. Their results showed that gifted students scored well above the 9th grade norms on both cognitive resources and involvement in career planning. Again, these results provided support for the advanced level of career awareness and involvement in decision making activities in gifted adolescents.

Finally, in a third study, Kelly (1992) used yet another measure of career development, Holland's My Vocational Situation (MVS; Holland, Daiger, & Power, 1980) to compare gifted to normal ability students. Scales on the MVS measure vocational identity (sense of how personal abilities fit into the work world), need for occupational information, perceived barriers to career progress, and range of occupational aspirations. Contrary to the findings of the other two studies, gifted students in this study did not score significantly higher than normal ability students on the vocational identity subscale. The only significant results were obtained on the perceived barriers subscale--gifted students perceived fewer barriers to career progress than students in the normal curriculum. These results were at odds with the findings reported by both Kelly and Colangelo (1990) and Kelly and Cobb (1991).

It is notable that different measures of career maturity/development were used in each of the studies, and that results converged across two of them. Reviews of career development instruments (e.g., Jepsen & Prediger, 1981; Tinsley, Bowman, & York, 1989) have suggested that each career maturity instrument measures slightly different constructs, which might help explain the lack of consistency in results across studies. Kelly (1992) implicated the following design weaknesses in the first two studies as contributors to the inconsistent

results: the use of a homogeneous, single-school sample and single global measure of career maturity in Kelly and Colangelo (1990), and the lack of an average achieving control group in Kelly and Cobb (1991). The Kelly study (1992), by contrast to these other two, included a more heterogeneous sample (two schools), a multi-dimensional measure of career development (Holland's MVS), and an average achieving control group, therefore appearing to be the most methodologically sound of the three studies. Additional research has not yet been conducted to clarify these discrepant results.

Further insight into the assessment of career maturity among intellectually gifted samples can be gleaned from reviews of career development and career maturity measures in the general vocational psychology literature. In a comprehensive review of the topic, Betz (1988) concluded that, on the whole, measures of career maturity and development lack definitional consistency as well as solid reliability and validity data. Research has done only a fair job of showing what these instruments measure, and has not shown that they relate in a meaningful way to outcomes such as realistic educational and vocational decisions or satisfying/successful career choices (Betz, 1988, 1992; Chartrand & Camp, 1991; Rounds & Tracy, 1990).

An additional factor highlighted in reviews of career maturity is relevant to its application with intellectually gifted populations. Career maturity, as measured by most instruments, is highly correlated with measures of intelligence and academic achievement (Betz, 1988; Jepsen & Prediger, 1981), with correlations ranging from the .30s to the .60s depending on the measures of career maturity and mental ability utilized. This finding raises the question of whether career maturity is a unique construct or one which might be



accounted for more parsimoniously by other, more encompassing general ability constructs (McNemar, 1964; Sanders, Lubinski, & Benbow, 1995). It is plausible that such strong correlations alone accounted for the positive relationships between career maturity and intellectual giftedness found in both the Kelly and Colangelo (1990) and Kelly and Cobb (1991) studies, whereas such a relationship might have played a less significant role with the more multi-dimensional measure used in the study by Kelly (1992). Regardless of the explanation, the strong relationship between career maturity and intelligence, combined with insufficient reliability and validity data on instruments measuring career maturity, appear to make the construct less than ideal for application to intellectually gifted adolescents.

In sum, the empirical literature on the nature of career development and maturity among gifted students is sparse (Kelly & Colangelo, 1990; Kelly & Cobb, 1991), consisting of only 3 empirical studies found in the present literature search, and support for the conclusion that gifted adolescents as a group are precocious in terms of career maturity is somewhat equivocal, with one study failing to replicate results from two earlier reports. Thus, general conclusions about the level of career maturity in gifted adolescents, as measured by current career development instruments, cannot be made. The intellectually gifted may be more advanced in their knowledge and planning of the future, or they may not be more advanced. To be sure, there are individual differences in this area, and educators and counselors generally share the belief that the educational, vocational, and career planning needs of gifted students are different than those of the majority of students in the normal curriculum (Silverman, 1993; Van Tassel-Baska, 1993).

### An Individual Differences/PE Fit Approach to Educational and Career Development

The career maturity construct discussed in the preceding sections fits squarely into the exploration stage of Super's developmental theory, where crystallization of preferences (a PE fit notion) is one of the major developmental tasks. If career maturity assessment instruments cannot detect reliable differences between gifted vs. average ability samples of adolescents, perhaps a more fruitful line of research to investigate the possibility of early educational and vocational development among the intellectually gifted would be to focus on variables used in traditional PE fit theories. As mentioned earlier in this review, the traditional assessment of abilities and preferences has an impressive record in predicting choice, competence, and fulfillment (Dawis, 1992) in adult populations. The paragraphs below outline a rationale for conceptualizing this possible research approach in developmental terms and applying it to gifted adolescents.

Developmental theorist Sandra Scarr (1992, 1993, 1996) asserted that the primary objective of human development is for individuals to become uniquely themselves. Scarr emphasized that on most behavioral traits, research indicates that environmental effects account for at least half of the variance in behavior, but that environments are not randomly assigned to people. Rather, individuals play an active role in constructing and interpreting their environments in ways that are dispositionally congruent for them—that is, people to a large extent choose their environments and react to them based on the personalities, interests, and talents they bring to the world (Scarr, 1996; Scarr & McCartney, 1983). This means that even traits stemming from a biological underpinning are in continual interaction with the environment to define experience for each individual.

The goal, then, for anyone trying to assist individuals in becoming themselves is to capitalize on dispositional propensities by offering opportunities and environments sufficient to nurture personal potential into fully functioning phenotypes. Scarr (1993, 1996; Scarr & McCartney, 1983) stressed the vital role that parents and other significant persons play in providing such supportive and enriching environments for children early in life. Then, as children grow older, they gradually begin to take a more active role in choosing their own environments in ways that best fit their unique talents, personalities, and preferences, while ignoring (or avoiding) other environments that do not seem to fit. During this transition time, typically adolescence, objective knowledge about emerging talents, personality dimensions, and preferences can be instrumental in helping individuals make educational and/or vocational decisions. What is necessary from an educational or vocational counseling perspective at this developmental stage is for individuals' predispositions to be identified as accurately as possible, so that appropriate opportunities and environments can be offered to foster the construction of experiences in line with developing potential. This endeavor necessitates understanding both the content domain of underlying potentials and the current level of aptitude in these areas.

Drawing on the work of Scarr for understanding human development, Lubinski (1996) noted that the individual differences tradition in psychology, into which PE fit vocational models clearly fall, is committed to facilitating human development through the careful measurement of personal characteristics, followed by counseling to assist in planning developmentally appropriate courses of action (e.g., educational opportunities). This tradition emphasizes giving information and skills to individuals to enable them to take active roles in

their own development (Tyler, 1992; Viteles, Brayfield, & Tyler, 1961; Williamson, 1965). As Lubinski (1996) states, "optimal development occurs when opportunities are tailored to an individuals' readiness to profit from opportunities" (p. 191). This "readiness," at least in the realm of educational and vocational decision-making, can be reliably evaluated through the systematic assessment of abilities and preferences as organized by TWA, one of the PE fit theories described earlier. Such assessments index the actualized phenotypes emanating from the genotypes underscored by Scarr.

Applying TWA to Gifted Youth. Extending TWA to gifted youth, analysis along the satisfactoriness dimension requires an accurate assessment of individuals' ability levels in order to facilitate placing them in maximally correspondent educational environments; that is, environments that match students' rates of learning with the pace of various curricula. Proper assessment along the satisfaction dimension, on the other hand, entails an accurate assessment of personal preferences to complement students' knowledge of their abilities. Assessing preferences can give students information about which possible educational paths they are likely to find more personally satisfying--environments that might maximize the correspondence between their interests and values and the rewards or reinforcements offered by different educational fields. Therefore, choosing optimal educational tracks involves finding educational areas for which individuals' abilities are well-suited and which they are likely to find enjoyable and rewarding.

Choosing optimal educational tracks might eventually lead to finding an optimal career. Indeed, analyses conducted by Lubinski et al. (1993) indicate that the same variables important for choosing and maintaining a commitment to a career path also apply to choosing

among contrasting academic tracks. For any given individual, the evolution from educational pursuits to eventual career paths might be viewed within TWA as a developmental process involving dynamic interactions between the person's abilities and preferences and the environment's ability requirements and reward systems. The research presented in Chapter 2 assesses whether abilities and preferences among gifted adolescents are truly predictive of educational environments they eventually choose.

Responding to Common Criticisms of PE Fit Theories. One critique of PE fit theories, such as TWA, leveled by some career development theorists is that assessments of interests, abilities, and values are static in nature, when in fact these personal factors may change over time. Indeed, PE fit theories do maintain that in order for these variables to be useful in educational/vocational planning, some level of stability over time is required (Dawis, 1991; Holland, 1976). Early in the history of interest assessment, E. K. Strong (1931), creator of the Strong Vocational Interest Blank, remarked that "if interests change from year to year, they are not trustworthy guides to the choice of a career" (p. 3). Evidence for such necessary stability has been reported for preferences in several studies over long intervals of time (e.g., for interests, see Swanson & Hansen, 1988; for values, see Arsenian, 1970). In fact, in a recent review of his vocational typology, Holland (1996) asserted that "aspirations--and interests to a lesser degree--are amenable to change and are responsive to experience. At the same time, stability appears to be the norm" (p. 400; emphasis added).

This evidence for stability does not, however, indicate that persons' preferences are entirely static in nature, only that at the broad or general level assessed by more global preference inventories there exists sufficient stability to make possible reliable prediction of

the types of educational and career choices persons make. Scarr (1996) might assert that evidence of both stability and change is not surprising, given the dynamic interactions between biological predispositions and the environments in which they manifest themselves. In other words, an individual's abilities and preferences certainly can change over time, but the general categories into which personal preferences fall, as well as the domains of a person's primary ability strengths, are likely to endure over time. Holland (1996) invoked the term "continuity" to describe this phenomenon of macro-level stability. Largely due to the measurable presence of this continuity, theories like TWA and Holland's typology achieve predictive capability, and thus counseling utility, while still allowing for natural developmental growth and change in abilities and preferences.

Yet another critique of PE fit theories applies specifically to their use with intellectually gifted populations. Within the gifted literature, the utility of PE fit approaches, such as TWA, for informing the educational and career decisions of gifted students has been questioned because of multipotentiality, i.e., the widespread existence of high-flat ability and preference profiles among gifted persons. If this criticism has merit, then both of the dominant theories in vocational psychology (PE fit and developmental) may be of questionable usefulness with the intellectually gifted. Further investigation into this claim, however, proves it to be highly suspect.

The contemporary literature addressing educational and career development among gifted students is replete with references to the topic of multipotentiality. Indeed, multipotentiality is one of the most pervasive themes in the literature on career education and career counseling for gifted persons (Emmet & Minor, 1993; Kerr & Claiborn, 1991;

Silverman, 1993; Rysiew, Shore, & Carson, 1994). As defined by Fredrickson and Rothney (1972), a multipotential person is "any individual who, when provided with appropriate environments, can select and develop any number of competencies to a high level" (p. vii). Rothney (1972) and Sanborn (1979a, 1979b) framed the concept more in operational terms when they asserted that multipotentiality is present in students who earn uniformly high scores across ability and achievement tests and exhibit multiple interests at equal intensities on interest inventories. Given such "high-flat" ability and interest profiles, multipotentiality is believed to lead to the reasonable consideration of multiple career options (Fredrickson, 1979; Kerr & Ghrist-Priebe, 1988). Moreover, because of high-flat performance on these measures, traditional vocational assessment instruments have been considered virtually useless in discriminative planning with the multipotential population (Kerr & Claiborn, 1991; Kerr & Erb, 1991; Kerr & Ghrist-Priebe, 1988).

Many authors have considered multipotentiality to be the number one concern of gifted students in the career decision-making process (Fredrickson, 1979, 1986; Jepsen, 1979; Kerr, 1981; Kerr & Ghrist-Priebe, 1988; Marshall, 1981; Sanborn, 1979a, 1979b), affecting not all, but most gifted students. Yet, despite its ubiquitous presence in writings and discussions about gifted and talented students, empirical support for the pervasiveness of multipotentiality among the gifted is lacking. As described in greater detail in the section below, above-level testing (i.e., using tests with sufficient ceilings) of abilities can usefully differentiate ability levels among the gifted (Stanley, 1977). In addition, studies dating to Terman (1925) suggest that interest inventories usefully differentiate interests in gifted populations. More recently, Achter et al. (1996) investigated the prevalence of

multipotentiality directly by comprehensively analyzing the ability, interest, and value profiles of over 1000 intellectually gifted adolescents. Using relatively broad criteria to define profile flatness (thereby increasing the chances of finding flat profiles, if they existed), these authors found that fewer than 5% of participants in their sample possessed combined ability, interest, and value profiles that could be defined as flat, or undifferentiated. Achter, Benbow, and Lubinski (1997) provided a review of the literature on multipotentiality and discussed the applied implications of these recent research findings.

That ability, interest, and value profiles are generally differentiated among the intellectually gifted provides initial support for using instruments that measure these vocational psychology constructs with gifted individuals. The remainder of this review is devoted to analyzing whether these variables are stable over time among the gifted (as they are among adults), and, if so, whether they predict important educational and vocational outcomes. The answers to these questions will provide valuable information regarding the educational and vocational development of intellectually gifted persons, and the extent to which above-level assessment can be used as a means for assisting them in this development.

#### Precocious Ability Development

Within gifted populations, by definition, intellectual abilities exist at a superior level. The emergence of superior intellectual abilities in children and adolescents, as measured by various standardized tests, is probably best conceptualized in terms of precocity (Benbow, 1991; Jackson & Butterfield, 1986; Sternberg & Davidson, 1985). The precocity position asserts not that gifted children differ qualitatively in terms of reasoning or cognitive functioning, but rather that they are ahead of their time--i.e., functioning at an intellectual



level indicative of persons a few to several years older (Benbow, 1991; Dark & Benbow, 1993). Preadolescent children who perform highly on tests like the Scholastic Aptitude Test (SAT) are believed to be reasoning at a level characteristic of students three to five years older. This was the belief driving the inception of the Study of Mathematically Precocious Youth (SMPY; Stanley, 1974; Stanley & Benbow, 1986), a longitudinal study of over 6,000 intellectually gifted individuals now in its third decade (Lubinski & Benbow, 1994).

Working with extremely precocious children, Leta Stetter Hollingworth (1927, 1942) observed that the early detection of intellectual giftedness fostered the optimal development of their talents. Similar insights into the advanced educational needs of the intellectually gifted have been offered by Terman and other eminent psychologists throughout the century (e.g., Paterson, 1957; Pressey, 1946, 1967; Seashore, 1922). More recently, Julian Stanley, with his SMPY research and service program initiated at Johns Hopkins University, advocated the widespread use of above-level testing for identifying intellectual precocity among gifted adolescents (Keating & Stanley, 1972; Stanley, 1977). Stanley and his colleagues were the first to systematically use college entrance exams--the SAT, and more recently the ACT (Benbow, 1991), tests typically taken by college-bound high school juniors and seniors--to differentiate levels of ability in both math and verbal domains for gifted adolescents (ages 12-14) who scored in the top one to three percent on conventional achievement tests. By raising the ceiling of test difficulty, above-level ability testing has the benefit of spreading out high ability students and distinguishing the able from the exceptionally able. Such testing gives individual gifted students, as well as their teachers and parents, a clearer picture of their exceptional strengths and relative weaknesses in

mathematical and verbal ability domains--something that cannot be gleaned from high-flat performance on grade-level achievement tests. This valuable information can then be used to tailor differential educational programming long recognized as necessary for gifted students (Benbow, 1991; Benbow & Stanley, 1996).

The use of above-level ability testing with intellectually gifted populations provides a valid way of assessing a key component to achieving satisfactoriness in TWA. According to the theory, an individual's abilities and skills are the primary predictors of success in vocational environments, a hypothesis supported by research with adult populations (Austin & Hanisch, 1990; Schmidt et al., 1992; Wilk, Desmarais, & Sackett, 1995). For the intellectually gifted, an accurate assessment of ability level can help in placing a student in a maximally correspondent educational environment, i.e., one that matches the student's developmental level. SMPY, and the talent search model that has evolved from it, has achieved significant success in identifying gifted students, characterizing their patterns of abilities, and offering opportunities and suggestions for finding correspondent educational environments (Benbow, 1991; Cohn, 1991; Stanley, 1977).

Intellectual ability also has been shown to be predictive of later life outcomes among gifted samples, similar to its function among more intellectually heterogeneous samples. Studying mathematically gifted individuals from SMPY, Benbow (1992) empirically examined the common belief in a threshold effect--the notion that there exists a threshold of ability above which few noticeable differences in vocational or career outcomes emerge. Instead of a threshold effect, Benbow (1992) found significant differences in career success between individuals in the top and bottom quartiles of the top 1% in mathematical ability as

assessed in early adolescence. In another study, Humphreys et al. (1993) used a sub-sample of high ability, high school students (top 20% in either general intelligence, spatial-mathematical abilities, or verbal-mathematical abilities) from Project Talent and showed that verbal, mathematical, and spatial abilities can reliably predict group membership in careers such as engineering, physical sciences, humanities, social sciences, and creative arts. It seems clear, therefore, that ability assessment among the intellectually gifted at an early age is useful in predicting both types of vocational choices and levels of success.

#### Early Crystallization of Preferences Among the Gifted

With respect to the satisfaction dimension of TWA, investigators have recently turned their attention to the possible presence of precocity among the gifted in the vocational preference domain, conceptualized as early crystallization of interests and values. Roe (1956) asserted that, on average, interests tend to crystallize by approximately age 18 in the general population. This general finding guided the development of vocational preference instruments, which typically target persons from high school age and above. Among the intellectually gifted, however, crystallization may occur at an earlier age. If this is the case, above-level preference assessment may be integrated with above-level ability testing to assist in early educational and vocational planning with gifted students, even though these individuals may be several years away from vocational or career choices.

Several pieces of evidence have emerged to support this line of thinking. As noted previously, many career educators and teachers of the gifted have asserted that interests, values, and other preferences appear to crystallize earlier in this special population (Milne, 1979). In empirical studies, Flanagan and Cooley (1966) found that gifted students tended to

have more developed interests and a better understanding of their personal values and attitudes than students not identified as gifted, and Terman (1954) noted that childhood interests of gifted individuals discriminated several years later between scientists and non-scientists, and that the Strong Vocational Interest Blank (now Strong Interest Inventory) could usefully differentiate between interests in intellectually gifted samples.

More recently, a study by Lubinski et al. (1995) provided support for the general stability of vocational interest patterns in gifted individuals over a fifteen year period from adolescence to adulthood (age 13 to age 28). Specifically, the median intraindividual correlation among Holland's RIASEC themes for 162 participants who completed the Strong Interest Inventory at both ages was .57. Moreover, the dominant theme for any individual at age 13 was significantly more likely than chance to be either dominant or adjacent to the dominant theme at age 28 (following the hexagonal organization of RIASEC; Holland, 1985). A constructive replication of Lubinski et al. (1995) analyzing personal values among the gifted supported the generality of these findings. Lubinski et al. (1996) assessed the temporal stability of the Study of Values (SOV; Allport, Vernon, & Lindzey, 1970) among an independent sample of 202 intellectually gifted participants over a 20-year period from age 13 to age 33, finding a median intraindividual correlation of .39 among the six SOV themes. Further, the dominant theme at age 13 was significantly more likely than chance to be dominant or adjacent to the dominant theme at age 33 (see Lubinski et al., 1996, for definition of adjacency). These results support the notion of early crystallization of preferences among the gifted, suggesting that continuity (Holland, 1996) of vocational

preferences in this population emerges up to five years before its establishment in more heterogeneous populations.

Finally, a comprehensive study of the structure and construct validity of both interests and values among the intellectually gifted by Schmidt et al. (1997) recently demonstrated concurrent and (one-year) predictive validity of the Strong and SOV with respect to forecasting several ability, personality, and biographical variables.

### Conclusion and Focus of the Present Study

Collectively, the recent studies casting doubt on the concept of multipotentiality (Achter et al., 1996, 1997) and those highlighting the longitudinal stability of preferences among the gifted (Lubinski et al., 1995; Lubinski et al., 1996) demonstrate that, in addition to abilities, factors critical to making educational and career decisions--i.e., interests and values--are relatively stable over time and contain enough fidelity to potentially be useful with intellectually gifted adolescents. What remains to be shown is whether measured preferences among the gifted can forecast actual educational and work environments over long temporal gaps, above and beyond the predictive power of abilities (Lubinski et al., 1996). If preferences contribute incremental validity (relative to abilities) to the prediction of eventual educational and vocational outcomes, they can be legitimately called upon in facilitating educational and career counseling with gifted persons as young as early adolescence.

The research study reported in Chapter 2 addresses the above question by analyzing the relationship between the abilities and values of gifted students, conjointly assessed at approximately age 13, with respect to the gifted students' completed college degree field. The study will make use of several theoretical and empirical findings discussed above. TWA.

which comprehensively incorporates both abilities and preferences into a framework for understanding educational and vocational decision-making, will be used as the over-arching theory guiding the study. Within this framework, S. P. Snow's (1959) two cultures will be utilized to organize salient ability and preference clusterings among participants. Results will be discussed in light of both theoretical and applied implications.

**CHAPTER 2. THE INCREMENTAL VALIDITY OF PREFERENCES RELATIVE  
TO ABILITIES FOR PREDICTING COMPLETED COLLEGE MAJOR AMONG  
INTELLECTUALLY GIFTED ADOLESCENTS**

A paper submitted to the Journal of Educational Psychology

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**Abstract**

Using the Theory of Work Adjustment (Dawis & Lofquist, 1984; Lofquist & Dawis, 1991) and C. P. Snow's (1959) conceptualization of "two cultures" as theoretical frameworks, this paper analyzed the incremental validity of above-level preference assessment (relative to abilities) in predicting humanities, math-science, or other college majors completed by the intellectually gifted. Discriminant analysis results indicated that age-13 SAT and Study of Values assessments of 432 intellectually gifted adolescents each provided unique and valuable information to the prediction of type of college major completed 10 years after initial assessment. These positive findings add to growing support for the notion of early crystallization of preferences among the gifted and lend further credence to applying above-level ability and preference assessment in facilitating educational and early career planning among intellectually gifted adolescents.

### Introduction

The idea that children and adolescents with exceptional intellectual gifts begin at an earlier age to think about careers is not new (Kerr & Erb, 1991; Milne, 1979). Empirical evidence exists to suggest that advanced educational and career thinking is present in many gifted youth, most likely as an outgrowth of their advanced cognitive development (Silverman, 1993). In fact, Willings (1986) suggested that most gifted students begin thinking seriously about their work futures by the age of nine. Typically, however, structured career search programs in schools are not implemented until the senior high years, and by that time they may be developmentally out of "sync" for gifted students (Kerr, 1981; Willings, 1986).

Systematic efforts to evaluate and address the apparent early development of career planning have only recently emerged in the gifted literature. The delay in studying this issue can be at least partially attributed to a strongly held belief among educators and counselors in the notion of multipotentiality, i.e., the seemingly ubiquitous presence of high-flat ability and preference profiles among intellectually gifted persons (Fredrickson, 1979, 1986; Jepsen, 1979; Kerr, 1981; Marshall, 1981; Rothney, 1972; Sanborn, 1979a, 1979b)—an apparent conundrum that has done little to dispel the common myth that gifted students "can be anything they want to be" (Achter, Benbow, & Lubinski, 1997; Tyler, 1992; Kerr 1981). Given "high-flat" ability and preference profiles, multipotentiality is believed to lead to the reasonable consideration of multiple career options (Fredrickson, 1979; Kerr & Ghrist-Priebe, 1988) and difficulty in discriminative planning. For this reason, several writers in the literature on intellectually gifted students have questioned the utility of measuring abilities



and interests--two mainstay constructs in vocational psychology--for informing educational and career decision-making (Kerr & Claiborn, 1991; Kerr & Erb, 1991; Kerr & Ghrist-Priebe, 1988).

Empirical research has produced results inconsistent with the notion of multipotentiality. For instance, above-level ability testing (i.e., using tests with sufficient ceilings) has proven vitally useful in differentiating ability levels among the gifted (Stanley, 1977), and studies dating back to Terman (1925) suggest that interest inventories usefully differentiate interests in gifted populations. More recently, Achter, Lubinski, and Benbow (1996) investigated the prevalence of multipotentiality directly by comprehensively analyzing the ability, interest, and value profiles of over 1000 intellectually gifted adolescents. Using relatively broad criteria to define profile flatness (thereby increasing the chances of finding flat profiles, if they existed), these authors found that fewer than 5% of participants in their sample possessed combined ability, interest, and value profiles that could be defined as flat, or undifferentiated. For the interested reader, Achter et al. (1997) provided a review of literature on multipotentiality and discussed the applied implications of these recent research findings.

The finding that ability, interest, and value profiles are generally differentiated among intellectually gifted adolescents provides initial support for using instruments that measure these vocational constructs with these individuals. However, further evidence for the reliability and validity of these instruments among the gifted must be evaluated before their use with this special population can be advocated. Investigations in these areas will provide valuable information regarding the educational and vocational development of intellectually

gifted persons, and will establish the extent to which above-level assessment can be used as a means for facilitating this development.

### Precocious Ability Development

Working with extremely precocious children, Leta Stetter Hollingworth (1942) observed that the early detection of intellectual giftedness fostered the optimal development of their talents. Several years later, Julian Stanley, with the SMPY research and service program he initiated at Johns Hopkins University, advocated for widespread use of above-level-testing for identifying intellectual precocity among gifted adolescents (Keating & Stanley, 1972; Stanley, 1977). Stanley and his colleagues have accumulated over 25 years of success in identifying gifted adolescents in this way and using information about their unique ability profiles to provide much needed differential educational programming for gifted students (Benbow, 1991; Benbow & Stanley, 1996).

Among gifted samples, intellectual ability has been shown to be predictive of vocational choice (Humphreys, Lubinski, and Yao, 1993) and level of success (Benbow, 1992), similar to findings among more intellectually heterogeneous samples (see Austin & Hanisch, 1990; Wilk, Desmarais, & Sackett, 1995). Despite these common findings, vocational counselors frequently overlook the assessment of abilities in favor of interests in working with individuals, a fact lamented by some researchers in vocational psychology (Austin & Hanisch, 1990). An accurate assessment of abilities is seen as imperative for working with the intellectually gifted, who by definition are distinguished by their superior intellectual abilities.

While knowledge of abilities is necessary, it is not sufficient for helping the intellectually gifted choose among competing educational and work environments. Personal preferences are important, too. The systematic assessment of preferences has an impressive history of being used effectively in vocational counseling (Borgen, 1991; Dawis, 1991; Hackett & Lent, 1992) with mature populations, and its potential early application to the intellectually gifted has recently come under careful investigation.

#### Early Crystallization of Preferences

Super (1953; Super, Savickas, & Super, 1996) theorized that crystallization of interests occurs during the exploration stage of vocational development, somewhere between ages 14 and 24. Providing a more specific benchmark, Roe (1956) asserted that in the general population personal preferences tend to crystallize (i.e., stabilize) by approximately age 18. More recently, Holland (1996) invoked the term “continuity” to refer to the general stability of preferences, observed throughout adulthood in most individuals, that allows for accurate predictions to be made regarding the nature of persons’ vocational choices. Knowledge that preferences begin to crystallize in early adulthood has guided the development of vocational preference instruments, which are generally intended for use with persons of high school age and older. Many career educators and teachers of the gifted have asserted, however, that among the intellectually gifted, the emergence of continuity, or crystallization, of preferences may occur at an earlier age (Milne, 1979). In early empirical studies, Flanagan and Cooley (1966) found that gifted students tended to have more developed interests and a better understanding of their personal values and attitudes than average ability students, and Terman (1954) noted that the Strong Vocational Interest Blank (Strong, 1927; now Strong

Interest Inventory) could differentiate between interests in intellectually gifted samples, and that childhood interests of gifted individuals discriminated several years later between scientists and non-scientists.

With this background, and with the waning influence of the multipotentiality concept, investigators have recently turned their attention to the possible presence of precocity among the gifted in the vocational preference domain, conceptualized as early crystallization of interests and values.

A study by Lubinski, Benbow, and Ryan (1995) provided support for the longitudinal stability of vocational interest patterns in gifted 13 year-olds over a fifteen year period from adolescence to adulthood (age 13 to age 28). Specifically, the median intraindividual correlation among Holland's RIASEC themes for 162 participants who completed the Strong Interest Inventory at both ages was .57. Moreover, the dominant theme for any individual at age 13 was significantly more likely than chance to be either dominant or adjacent to the dominant theme at age 28 (following the hexagonal organization of RIASEC; Holland, 1985). A constructive replication of Lubinski et al. (1995) analyzing personal values among the gifted supported the generality of these findings. Lubinski, Schmidt, & Benbow (1996) assessed the temporal stability of the Study of Values (SOV; Allport, Vernon, & Lindzey, 1970) among an independent sample of 202 intellectually gifted participants over a 20-year period from age 13 to age 33, finding a median intraindividual correlation of .39 among the six SOV themes. Further, the dominant theme at age 13 was significantly more likely than chance to be dominant or adjacent to the dominant theme at age 33 (see Lubinski et al., 1996, for definition of adjacency). These results support the notion of early crystallization of

preferences among the gifted, suggesting that continuity (Holland, 1996) of vocational preferences in this population emerges up to five years before its establishment in more heterogeneous populations.

Studies analyzing multipotentiality, above-level ability testing, and the longitudinal stability of preferences among intellectually gifted young adolescents collectively suggest that factors critical to making educational and career decisions--i.e., abilities, interests and values--might effectively be used in combination to serve the educational and early career planning needs of gifted young adolescents. The strength of this statement could be bolstered by additional research into the incremental validity of above-level preference assessment, relative to abilities. What is known at this time is that interests and values, measured at approximately age 13, are relatively stable over time and contain enough fidelity to potentially be useful with intellectually gifted adolescents. A piece of validity evidence that remains to be shown is whether measured preferences among gifted adolescents can forecast actual educational and work environments chosen over long temporal gaps (Benbow & Stanley, 1996), above and beyond the predictive power of abilities (Lubinski et al., 1996).

Early research efforts analyzing the validity of using above-level preference assessment instruments with intellectually gifted adolescents have produced positive results. In a comprehensive study of the structure and construct validity of both interests and values among intellectually gifted adolescents, Schmidt, Lubinski, and Benbow (1997) demonstrated concurrent and (one-year) predictive validity of the Strong-Campbell Interest Inventory (Hansen & Campbell, 1985) and Study of Values (Allport, Vernon, & Lindzey, 1970) with respect to forecasting several ability, personality, and biographical variables. The

present study examined another vital validity question: whether preferences can further enhance the prediction of educational outcomes (i.e., completed college major) longitudinally.

The present research addressed the validity of using above-level assessment of preferences with the intellectually gifted by analyzing the relationship between the abilities and values of gifted students, assessed at age 13, and the college majors completed by these individuals later in life. At the most general level, it was hypothesized that preferences (i.e., values) would add incremental validity to the prediction of completed college major, beyond the predictive power of abilities.

#### Theoretical Organization of the Present Study

The study made use of the theoretical and empirical findings outlined below. Generally, the Theory of Work Adjustment (TWA; Dawis & Lofquist, 1984; Lofquist & Dawis, 1991) was used as the over-arching framework guiding the study. Within this framework, C. P. Snow's (1959) explication of two intellectual cultures was applied to organize college majors into criterion groups.

#### The Theory of Work Adjustment

TWA integrates the important dimensions of abilities and vocational preferences (interests and values) into a coherent theory about work adjustment. Following TWA, person-environment correspondence is conceptualized along two dimensions: satisfactoriness and satisfaction. In order to achieve satisfactoriness, there must be correspondence between the abilities of a person and the ability requirements, or task demands, of the environment (e.g., occupation or educational track) in which the person is operating. To reach a high level of

satisfaction, on the other hand, the preferences of an individual must correspond with the types of reinforcers provided by the environment (e.g., compensation, particular working conditions). Preferences in TWA are often operationalized as interests and values (Dawis & Lofquist, 1984; Lofquist & Dawis, 1991).

The predicted outcome of the joint correspondence on TWA's two major dimensions, satisfactoriness and satisfaction, is tenure, or the amount of time spent in a particular environment. The higher the levels of satisfactoriness and satisfaction, the more the environment and the individual, respectively, will invest time in interacting with one another. Optimal adjustment, then, is predicted when personal abilities match ability requirements of the environment and personal preferences (i.e., interests and values) match the reinforcers available from the environment. While developed as a model of vocational adjustment, the constituent components of TWA are the same variables that structure critical antecedent decisions to vocational choice (Lofquist & Dawis, 1991), such as choosing various educational tracks (Lubinski, Benbow, & Sanders, 1993). TWA guided the present investigation in this way.

For the practical application of TWA, it is necessary to have a system for classifying persons and environments in terms commensurate with the above-mentioned dimensions. Classification systems attempt to explain and predict relationships between personal characteristics (e.g., abilities and interests) and the characteristics of environments (e.g., ability requirements and reinforcers) in which individuals operate. For this study, the framework used for conceptualizing the nature of the ability/preference configurations that

discriminate among groups of intellectually gifted young adolescents was C. P. Snow's (1959) grouping of humanistic and scientific cultures.

### The Two Cultures

One of the most concise theoretical statements offered to organize categories of academic/intellectual pursuits was supplied by C. P. Snow's (1959) demarcation of "two cultures," humanistic and scientific. Snow, reflecting on his experience as both a writer and scientist, observed that these two distinct intellectual cultures seem to exist in academic settings and are clearly different in the ways they view the world and approach and solve problems. In their extreme manifestations--i.e., when the attributes that distinguish the two groups become more distinct--these two cultures are so psychologically dissimilar that communication between the two becomes strained, even though collaboration and cooperation might frequently produce beneficial outcomes stemming from mutual goals (Snow, 1959). Snow's astute observation about the existence of two cultures has utility for the present research because of its simplicity and because of relatively well-understood relationships of the two cultures to both abilities and preferences in normative samples.

In the ability arena, the two cultures parallel Vernon's (1961) two major group factors, verbal-educational (corresponding to the Humanities) and mechanical-spatial (corresponding to the sciences) (Humphreys et al., 1993). Following TWA, persons tend to gravitate toward the broad content domains that best match both their abilities (Wilk et al., 1995) and preferences. In the preference domain, Borgen (1972) used a classification system resembling Snow's dichotomy, achieving 72.5% accuracy in predicting science vs. non-science career choices from the interest profiles of a group of National Merit Scholar students 3 years after



initial assessment. Interestingly, the psychological reality of Snow's two cultures also has received empirical support from both experimental (Kimble, 1984) and differential (Humphreys et al., 1993) psychological inquiry.

Reviewing research conducted with normative adult samples, Ackerman (1996) and colleagues (Ackerman & Heggestad, 1997) have recently published theoretical and meta-analytic studies integrating an understanding of relationships between intelligence, personality, and interests--based on well-established definitions of these constructs--that conforms to Snow's observations. Among other things, their meta-analyses revealed robust relationships between the combinations of Spatial and Math abilities with Holland's Realistic and Investigative interests, and between Verbal abilities with Artistic interests (primarily) and Investigative interests (secondarily). These ability/interest combinations were also found to be related to knowledge in areas strikingly similar to Snow's distinction. Specifically, Ackerman (1996) reported that the Verbal/Artistic combination of abilities and interests was highly correlated with self-reported knowledge in the humanities and arts, and that the Math-Spatial/Investigative combination was highly correlated with self-reported knowledge in math, physical sciences, and technology. Interestingly, Ackerman and Heggestad (1997) reported that the strongest relationships to specific intellectual abilities exist with Realistic, Investigative and Artistic interests (those most strongly associated with the two cultures), whereas Social, Enterprising, and Conventional interest domains had weaker relationships with specific intellectual ability domains. Schmidt et al. (1997) recently demonstrated that the ability/preference clusterings reported by Ackerman are present among intellectually gifted persons at age 13 as well.

Snow's two cultures will be used to categorize college majors of gifted students in this study. This choice of grouping was based on three factors. First of all, sample sizes of SMPY participants meeting the requirements for inclusion in the study were relatively small for multivariate analyses ( $N = 432$ ), necessitating a smaller number of criterion groups. Second, Snow's simple classification system reflects his observations specifically of different types of intellectual environments, making it intuitively appropriate for application to a group of intellectually gifted individuals, who at age 13 were motivated to pursue accelerative educational opportunities. Third, this distinction has received support from research analyzing both abilities and preferences in normative high school (Humphreys et al., 1993) and adult samples (Ackerman, 1996), allowing hypothesis generation based on prior empirical research.

The present study was conducted using the SOV to assess values in the preference arena. Much like interests, values represent a viable domain of preferences related to vocational choice and satisfaction (Dawis, 1991). Although interest measurement is more popular today, questionnaires measuring both values and interests have been widely used and are content valid with gifted populations. Interestingly, the Strong Interest Inventory (assessing Holland's interest constructs) and SOV are known to assess overlapping preference domains in intellectually gifted adolescents (Schmidt et al., 1997). Schmidt et al. (1997) reported correlations among intellectually gifted 13-year olds between Holland's RIASEC themes and the six values themes from the SOV that are relevant to the present study. Among gifted adolescents, the Theoretical value theme and Investigative interests correlated .29, Artistic interests and Aesthetic values correlated .53, and Social interests and

Social values correlated .42. Each of these correlations was statistically significant and represented the highest (positive) cross-instrument correlation for the respective subtests. These correlations can be considered conservative estimates due to attenuation caused by the ipsative scaling of the SOV (Schmidt et al., 1997).

The relationships between ability domains and preference themes described by Ackerman (1996) guided hypothesis generation in the present study, with content-similar values inserted for interests, where appropriate.

### Specific Hypotheses

To restate, the present study analyzed whether above-level assessment of values added incremental validity (relative to abilities) in the prediction of completed college major field, categorized according to C. P. Snow's two cultures, over a 10-year temporal gap. The overarching theme of this project was to ascertain whether both abilities and preferences provide unique and valuable predictive information that might justify their combined use in counseling intellectually gifted young adolescents. Hypotheses for the present study are given below, from general to specific, following the conceptualizations outlined in previous sections.

1. Age 13 preferences (values) will provide statistically significant incremental validity to the prediction of completed college major category, relative to abilities.
2. Age 13 abilities will provide statistically significant incremental validity to the prediction of completed college major category, relative to preferences (values).
3. Math ability will be positively associated with prediction of group membership in Science-related majors.

4. Verbal ability will be positively associated with prediction of majors in the Humanities.
5. Theoretical value scores will be positively associated with prediction of group membership in Science-related majors.
6. Aesthetic value scores will be positively associated with prediction of majors in the Humanities.

A third grouping of college majors was also included to capture all those that did not fit neatly into either the science or humanities groups. No hypotheses were made regarding this third group due to the heterogeneous nature of majors included in it.

## Method

### Participants

The participants for this study were drawn from Cohorts 1, 2, and 3 of SMPY's planned fifty-year longitudinal study of intellectual talent (Lubinski & Benbow, 1994), currently in its third decade. Participants in SMPY were initially identified at age 12 or 13, via talent searches, by scoring in approximately the top 3% on standardized achievement tests appropriate for their grade level (Cohn, 1991). Then, as part of the talent search, these gifted students took the SAT, a test designed for college-bound high school students. A select group of talent search participants were subsequently invited for inclusion in SMPY by meeting specific SAT score criteria established for the current cohort being identified at that time (see description of cohorts below). After selection, SMPY participants were administered an additional series of tests and questionnaires for research purposes. Students in the various cohorts were included in the present study if they completed the SAT and the Study of

Values (Allport et al., 1970) by age 12 or 13, and reported their completed college major as part of a 10-year follow-up questionnaire. A total of four hundred thirty-two SMPY participants (272 male, 160 female) met these criteria. Detailed descriptions of the three SMPY cohorts included in this study follow in the paragraphs below.

Cohort 1 ( $n = 2188$ ) includes students (96% Caucasian, 2% Asian, 2% other) who scored, before age 14, SAT-V  $\geq 370$  or SAT-M  $\geq 390$ , original scale, as part of SMPY's 1972, 1973, or 1974 talent searches. These score cutoffs represented the average SAT performance of high school females at that time, and approximate the top 1% of general intellectual ability for seventh grade students (Lubinski & Benbow, 1994). These participants were drawn primarily from the state of Maryland, but a large concentration was from the greater Baltimore/Washington area. One hundred ninety-seven (99 male and 98 female) members of Cohort 1 qualified for inclusion in this study.

Cohort 2 ( $n = 778$ ) is made up of talent search participants (89% Caucasian, 6% Asian, 5% other) from 1976, 1978, and 1979 talent searches who scored among the top one-third of talent search SAT scores (i.e., SAT-V  $\geq 430$  or SAT-M  $\geq 500$ , original scale); they represent approximately the top 0.5% in general intellectual ability for their age group. These participants were drawn from Mid-Atlantic states. One hundred sixty (113 male, 47 female) Cohort 2 participants were included in this study.

The most select group of SMPY participants are in Cohort 3 ( $n = 423$ ) and were identified between 1980 and 1983. These students (77% Caucasian, 19% Asian; 4% other) approximate the top 1 in 10,000 (or top .01%) in mathematical or verbal reasoning ability by having scored, before age 13, SAT-V  $\geq 630$  and/or SAT-M  $\geq 700$ , original scale. These

participants were drawn from talent searches throughout the entire nation. Seventy-five (60 male, 15 female) Cohort 3 participants met the criteria for inclusion in the present study.

Longitudinal response rates and a summary of sub-samples of the three SMPY cohorts used in this study are contained in Table 1.

Table 1

Study Participants and Longitudinal Response Rates, by Cohort

Cohort (dates identified)	Pool of Potential Participants (n) <sup>a</sup>	<u>Five-year follow-up</u>		<u>Ten-year follow-up</u>	
		<u>n</u>	% response	<u>n</u>	% response
1 (1972-1974)	364	259	71	197	54
2 (1976-1979)	211	186	88	160	76
3 (1980-1983)	124	80	65	75	60
Total	699	525	75	432	62

Potential participants were those who completed both the SAT and Study of Values at age 13.

Predictive Measures

Scholastic Aptitude Test (SAT). The SAT was designed as a college-entrance exam, to be taken by college-bound high school juniors and seniors to predict college performance. It consists of mathematical (SAT-M) and verbal (SAT-V) subtests. Scores for each subtest are standardized on a scale ranging from 200 to 800, with a score of 500 representing the mean for college-bound high school seniors in the original normative sample.

Over time, scores on SAT-M and SAT-V diverged, with a significant decline in average SAT-V scores resulting in average SAT-V and average SAT-M scores differing by

approximately 70 points in normative samples (e.g., a score of 430 on SAT-V and a score of 500 on SAT-M were normatively equivalent). This problem was addressed with a major rescaling effort in 1995 that utilized a new normative sample and once again equalized the means on each scale. The SAT also underwent modest content changes to both subtests in 1995, but neither the scaling nor content changes affected the present study, as all participants took the SAT prior to 1995. To approximate accurate mean comparisons in the study sample, therefore, 70 points must be added to the SAT-V mean.

Study of Values. The SOV (Allport et al., 1970) is a measure of personality-related values, conceptualized as basic motives or interests. The SOV yields scores along six dimensions (brief descriptions are given in parentheses): Theoretical (concern for the discovery of truth; tend think in empirical, critical, and rational terms), Economic (value in what is practical or useful; tend to judge matters in terms of tangible, financial implications), Aesthetic (dominant value is in form and harmony; sensitive to grace, beauty, and symmetry), Social (altruistic and genuine philanthropic love of people; tend to be kind, sympathetic, and unselfish), Political (interested primarily in power, influence, renown, and leadership), and Religious (value unity; tend to be mystical and seek to relate themselves to a higher reality).

The SOV is an ipsative instrument, requiring respondents to make rank judgments between various value statements. Because of its ipsative nature, the SOV measures the relative strength of all six values intraindividually. The SOV was standardized on a college population and is intended for use with persons from grade 10 to adulthood, although advanced education may be necessary to decipher some of the language used to convey

choices (Rabinowitz, 1984). Reliability information reported by the Manual (Allport et al., 1970) includes split-half reliability coefficients ranging from .73 (Theoretical) to .90 (Religious), and test-retest (over one-month) reliability coefficients ranging from .77 (Social) to .92 (Economic). Twenty-year test-retest reliability of the SOV among the intellectually gifted was reported by Lubinski et al. (1996), as detailed here in the introduction.

### Procedure

Each cohort of SMPY participants is followed longitudinally. At approximately age 13, participants in Cohorts 1 through 3 completed the SAT and instruments such as the SOV as part of an extensive battery of assessment instruments and background questionnaires given by SMPY. Follow-up surveys are scheduled to occur at 5 to 15 year intervals through retirement age. The procedure for collecting the 10-year follow-up questionnaires relevant to this study was similar for all cohorts. Participants initially were mailed a questionnaire and then later contacted, if necessary, via mail or telephone to encourage questionnaire completion.

Completed college major was the outcome variable chosen as criterion for this study. This variable was one piece of information collected in a comprehensive 10-year follow-up questionnaire, when participants were approximately age 23.

Criterion Groups. For purposes of analyzing these data, the college major variable was re-coded to create three criterion groups: "Math-Science," "Humanities," and "Other." This grouping is based on C. P. Snow's (1959) demarcation of "two cultures" described earlier, and allowed for an analysis of whether age 13 abilities and preferences can be used to distinguish, ten years later, between two somewhat distinct intellectual groups, the scientists



and the humanists, and a group of persons who made educational choices that do not fit clearly into either of these two intellectual cultures.

The goal of the classification into Math-Science vs. Humanities groups was to create groups that were pure enough to produce unambiguous results, and large enough to conduct meaningful statistical analyses. With this in mind, classification involved a two-step process that proceeded in the following manner. A comprehensive list of fields of study from the Educational Testing Service was utilized during step one to categorize into the Math-Science group all majors listed under the following headings: Biological sciences, Computer science, Engineering, Mathematics, and Physical sciences. Then, all majors listed under the headings Art, English and Literature, Foreign languages, History and Cultures, Music, Philosophy and Religion, and Theater arts, were classified into a Humanities group. Finally, majors listed under other headings were placed in the "Other" group.

During the second classification step, the veracity of this simple procedure was assessed by consulting classification data based on Holland's (1985) RIASEC theory of vocational interests and environments. Extensive theoretical and empirical work has been done to classify both occupations and academic fields based on Holland's system, with the third edition of the Dictionary of Holland Occupational Codes (DHOC; Gottfredson and Holland, 1996) containing results of the most recent efforts. The Classification of Instructional Programs section of the DHOC was consulted to examine consistency among majors in the Math-Science and Humanities groups based on their two- and three-letter Holland codes. (Convention has evolved in vocational psychology to categorize both people and environments based on the top two or three scores obtained from questionnaires

measuring Holland's RIASEC themes.) In the case of Math-Science majors, IRE was the modal three-letter Holland code. Majors from the initial classification were retained in the Math-Science group if two of these three themes occupied the first two Holland code positions according to the DHOC Classification of Instructional Programs. A major was reclassified into the Other category if this criterion was not met. This screening resulted in the re-classification of only one major, Biology, which had a Holland code of IAR.

Due to the smaller sample size in the Humanities, all majors from initial classification were retained for the analyses. The majority of these majors (87%) contained the Artistic theme from Holland's classification in either the first or second Holland code position. The History majors were the only exception, with two-letter Holland codes of SE or ES. Fifteen of the sixty-seven participants (22%) grouped in the Humanities completed majors in history.

The final results of classification are contained in Table 2, complete with educational field headings and titles of individual majors. Note that the "Other" category consists predominantly of social science, business, and biology/health and medical majors, with a few miscellaneous other majors interspersed.

Table 2

Categorization of Completed College Major into Math-Science, Humanities, and Other Groups

Math-science ( <u>n</u> = 170, 57)	Humanities ( <u>n</u> = 34, 33)	Other ( <u>n</u> = 68, 70)
<b>Biological sciences</b>	<b>Art</b>	<b>Architecture</b> (2, 4)
biochemistry (3, 4)	art (0, 1)	<b>Biological sciences</b>
biophysics/bioengineering (0, 1)	film (1, 0)	biology (9, 9)

Table 2. (continued)

Math-science	Humanities	Other
<b>Biological sciences</b> (cont'd)	<b>Art</b> (cont'd)	<b>Business &amp; Commerce</b>
zoology (0, 1)	fine arts (1, 1)	accounting (5, 7)
<b>Computer science</b> (20, 8)	interior decorating (0, 1)	business & commerce (2, 1)
<b>Engineering</b>	photography (0, 1)	business mgt./admin. (4, 2)
aerospace engineering (5, 1)	studio art (0, 1)	data processing (3, 1)
chemical engineering (11, 3)	<b>English &amp; Literature</b>	finance & banking (1, 2)
civil engineering (3, 1)	creative writing (2, 1)	industrial management (1, 0)
computer engineering (4, 1)	english (3, 8)	marketing (2, 3)
electrical engineering (38, 6)	literature (1, 1)	secretarial studies (0, 1)
engineering, general (7, 0)	<b>Foreign languages</b>	<b>Communications</b> (1, 2)
engineering sciences (2, 1)	classical languages (0, 1)	<b>Education</b>
industrial engineering (3, 1)	foreign languages (0, 1)	elementary education (0, 2)
materials science (0, 1)	french (0, 1)	health education (0, 1)
mechanical engineering (10, 1)	linguistics (1, 1)	<b>Geography</b> (1, 1)
petroleum engineering (1, 0)	russian (0, 4)	<b>Health &amp; Medical</b>
<b>Mathematics</b>	<b>History &amp; Cultures</b>	health & safety (0, 1)
mathematics (27, 17)	american history (3, 2)	medical assisting (1, 0)
quantitative studies (1, 0)	european history (2, 0)	nursing (0, 6)
<b>Physical sciences</b>	history & cultures (7, 1)	pre-medicine (0, 3)
astronomy (1, 0)	<b>Music</b>	pre-veterinary medicine (0, 1)
chemistry (7, 5)	instrumental music (1, 2)	<b>Psychology</b> (4, 4)
earth science (2, 0)	music (2, 0)	<b>Social sciences</b>
geology (2, 1)	<b>Philosophy &amp; Religion</b>	anthropology (1, 1)
meteorology (1, 0)	philosophy (5, 1)	criminal justice (0, 1)
physical sciences (1, 0)	religion (3, 3)	economics (17, 2)

Table 2. (continued)

Math-science	Humanities	Other
<b>Physical sciences</b> (cont'd)	<b>Theater arts</b>	<b>Social sciences</b> (cont'd)
physics (21, 4)	drama (1, 0)	gov't. service/politics (1, 1)
	theater arts (1, 1)	international relations (1, 1)
		political science (9, 3)
		social sciences, general (0, 2)
		social work (0, 2)
		sociology (0, 4)
		<b>General studies</b> (2, 1)
		<b>Other</b> (1, 1)

Note. Educational field headings are in bold type. ns for groups and majors are in parentheses, by sex (male, female).

### Design and Analyses

To analyze the unique contributions of abilities and preferences in the prediction of completed college degree field, discriminant analysis was utilized. Discriminant analysis is a technique for predicting group membership, a categorical variable, from multiple predictor variables (Betz, 1987; Tatsuoka, 1988). The technique was designed for application to multivariate situations in which several predictor variables are believed to have differential effects on the probability of membership in two or more groups. Predicting group membership through discriminant analysis is viewed as a valuable component within the larger general context of predictive validation (Humphreys et al., 1993), and has been widely applied in vocational psychology studies focusing on occupational group membership (e.g., Donnay & Borgen, 1996). Here the procedure was used to forecast an antecedent to

occupational choice, 4-year college degree, which fits well within the context of contemporary theories that view vocational development as an ongoing process with critical milestones.

Discriminant analysis yields a prediction of group membership based on the linear composite or combination of predictor scores that best capture differences between the groups. Several useful pieces of information are yielded from a discriminant analysis to assist in evaluating results. First of all, the Wilks's lambda statistic represents the proportion of variance in discriminant scores not explained by group membership. Therefore,  $1 - \text{Wilks's lambda}$  represents the percentage of variance explained by group membership (Donnay & Borgen, 1996). Wilks's lambda has a chi-square distribution so that the statistical significance of discriminant functions yielded from the analysis can be evaluated. Second, and more practical in nature, the discriminant functions can be used to classify individuals into groups, and the accuracy of such classification can be assessed by comparing results from the discriminant analysis with base-rate or chance expectations. Third, the unique contribution of each variable to discriminating among criterion groups can be assessed by analyzing correlations between each independent variable and the discriminant functions. Essentially, these are loadings analogous to factor loadings in factor analysis (Betz, 1987) and thus also can be used to interpret the content of the functions. Finally, group centroids (weighted group means) are computed, representing the average weighted discriminant scores for participants in each criterion group. These centroids can be plotted graphically to visually represent the degree of separation between groups achieved by the discriminant functions. All

of these indices will be reported in the present study to evaluate the validity of predicting completed college major based on age 13 ability and preference scores.

## Results

### Univariate Analyses

Means and standard deviations for each predictor variable are presented in Tables 3 and 4. Table 3 shows these values for the total sample and by gender. On average, males scored much higher on SAT-M and females moderately higher on SAT-V. In general, males also produced more distinct values profiles, with average scores ranging from 32 to 48 and the Theoretical value theme dominating all others. Females on the other hand, produced more balanced values profiles, with average scores ranging from 36 to 45 and the Social value theme predominating. These gender differences are consistent with previous studies of ability and preference profiles among the intellectually gifted (Achter et al., 1996; Lubinski & Benbow, 1992; Lubinski et al., 1995, 1996; Schmidt et al., 1997).

Table 3

#### Means and Standard Deviations of Predictor Variables, by Gender

	<u>Total (n = 432)</u>		<u>Male (n = 272)</u>		<u>Female (n = 160)</u>	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
<b>Abilities</b>						
SAT-M	567	93	591	93	526	78
SAT-V	451	86	445	88	461	84
<b>Values</b>						
Theoretical	44.8	8.4	47.9	7.2	39.5	7.6
Economic	40.2	7.4	42.4	6.9	36.3	6.6

Table 3 (continued)

	<u>Total</u>		<u>Male</u>		<u>Female</u>	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Values (cont'd)						
Aesthetic	37.1	8.3	34.6	7.4	41.4	8.0
Social	41.0	7.4	38.7	6.2	45.1	7.4
Political	42.1	7.1	43.7	6.7	39.2	6.7
Religious	34.7	10.4	32.5	9.9	38.5	10.1

Table 4 presents these same descriptive statistics by college-major grouping. For purposes of highlighting information utilized by discriminant analysis, it is most helpful to focus on cross-group comparisons. Note first that, based on average SAT scores, the two intellectual cultures (Math-Science and Humanities) were more able than the Other group. Also, the Math-Science group had the highest average SAT-M score and the Humanities group the highest average SAT-V score. In addition, age 13 Theoretical values scores were most intense, on average, among participants completing Math-Science majors, and Aesthetic values were highest among those completing majors in the Humanities. The direction of these relationships were consistent with study hypothesis. It is also notable that the Other group had the highest average score on the Social theme, as a large proportion of this group was composed of persons who majored in social science, business, health and medical, and education fields--areas involving direct service to others. For interested readers, descriptive statistics broken down by both sex and college-major group can be found in the Appendix.

Table 4

Means and Standard Deviations of Predictor Variables, by Completed College Major Group

	<u>Math-science (n = 227)</u>		<u>Humanities (n = 67)</u>		<u>Other (n = 138)</u>	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Abilities						
SAT-M	590	97	545	84	539	80
SAT-V	452	94	478	83	437	72
Values						
Theoretical	47.8	7.9	42.7	8.3	41.0	7.4
Economic	41.7	7.7	37.9	7.4	38.7	6.3
Aesthetic	36.3	7.9	41.4	9.4	36.3	7.8
Social	39.2	7.0	42.2	8.3	43.5	6.7
Political	42.6	6.5	39.5	7.8	42.4	7.3
Religious	32.2	9.9	36.5	12.3	37.8	9.2

In subsequent analyses, only five of the six SOV themes were utilized. Because the SOV is an ipsative instrument, only five scores provide unique information statistically--the sixth score can be completely derived from the other five. The five themes chosen for the analyses were Theoretical, Economic, Aesthetic, Social, and Religious. The Political theme was excluded because it was believed theoretically to be least central to the task of distinguishing between Math-Science and Humanities groups.

Before proceeding to the multivariate analyses, it is helpful to examine, at the univariate level, the capacity of individual predictor variables to separate major groups from one another. To achieve this, the two SAT scales and five SOV themes were each examined separately in seven univariate analyses of variance (ANOVAs). Table 5 shows the results of



these analyses in terms of Wilks's lambda and  $F$  ratios. Recall that Wilks's lambda represents the proportion of variance not explained by group membership, and that subtracting this value from 1 yields the proportion of variance explained. Therefore, smaller Wilks's lambda statistics are associated with larger  $F$  values. All  $F$  values in Table 5 are statistically significant, indicating that when considered individually, all variables contributed to college-major group separation.

The following multivariate analyses provided several additional pieces of information for understanding and clarifying the relationship between these predictor variables and the criterion groups.

Table 5

Univariate Analysis of Group Separation

Variable	Wilks's lambda	F (2,429)
Abilities		
SAT-M	.93	16.24
SAT-V	.98	5.23*
Values		
Theoretical	.86	35.29
Economic	.95	11.72
Aesthetic	.95	10.97
Social	.93	16.93
Religious	.94	14.38

Note.  $N = 432$ . Unless otherwise indicated, all  $F$ s were significant at  $p < .00005$ .

\* $p < .006$ .

### Multivariate Analyses

Hierarchical results and hit rates. To test the hypothesis that preferences add incremental validity to abilities in the prediction of completed college major, a hierarchical discriminant function analysis was performed, with the two SAT scales entered initially and the five value themes from the SOV entered subsequently. For parity, the analysis was also performed with the values themes entered first followed by abilities, providing an index of the incremental validity of abilities, relative to values. Note from Table 6 that the complete equation (abilities plus values) produced an increase in between groups variance explained (denoted by a decrease in Wilks's lambda) over either the analysis involving exclusively abilities or exclusively values. The complete analyses also resulted in an increase in the percentage of participants accurately classified into groups over the analysis including only abilities (direct hits increased from 54% to 60%), in keeping with prior hypotheses<sup>1</sup>. The z-test for the difference between two proportions (following Glass & Stanley, 1970) showed this difference to be statistically significant ( $p = .04$ ). All three analyses produced hit rates that were meaningfully above base-rate expectations, a common benchmark for assessing the

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<sup>1</sup> Note from Table 6 that values accounted for 13% of incremental variance relative to abilities, whereas the unique contribution of abilities was appreciably less. Abilities accounted for 2% of incremental variance relative to values. Part of the explanation for this result lies in the restricted ability range inherent in SMPY selection criteria. Further, our ability set is somewhat mis-specified in that spatial/mechanical reasoning abilities were not available. Despite this restriction, and a missing variable that serves to under-determine the model, an examination of the hit-rates in the individual cells for each group revealed that the addition of abilities did improve discrimination of group membership in the Humanities, with hit-rates increasing from 9% (values alone) to 18% (abilities plus values). This improvement once again highlights the importance of assessing both abilities and preferences conjointly.

Table 6

Hierarchical Discriminant Function Results

Variables	No. of significant discriminant functions	Wilks's lambda	Direct hits (%)
SAT-Math and SAT-Verbal	2	.90	54
5 SOV themes (Theoretical, Economic, Aesthetic, Social, Religious)	2	.79	60
SAT-Math and SAT-Verbal plus 5 SOV themes (Theoretical, Economic, Aesthetic, Social, Religious)	2	.77	60

significance of hit rates (Afifi & Clark, 1990; Betz, 1987)<sup>2</sup>. Adding gender to these predictor variables did not further discriminate among college-major groups (Wilks's lambda = .76; direct hits = 60%).

A detailed break-down of classification results for the combined (ability and value) analysis is contained in Table 7. The hit rates for the three criterion groups were all above

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<sup>2</sup> Statistical classification is partially determined by base-rates, which are used to calculate cut scores for separation into groups (Afifi & Clark, 1990; Tatsuoka, 1988). For the results presented here, base-rates were set equal to the sample probabilities of membership in each group. Setting the base-rates at chance levels (i.e., 33%, see footnote 3) or at an estimate of actual population base-rates would result in different hit rates in each cell. Using base-rates from the population to which one intends to generalize is desirable when such information is available (Afifi & Clark, 1990), and using sample base-rates is most common in cases when sample estimates are not known (L. G. Humphreys, personal communication, July 1, 1997). Prediction of Humanities group membership in this study was affected by the heavy bias in the present sample toward Math-Science college majors, and would likely improve if group sizes were more balanced. The statistical problem of predicting rare events has been discussed at length by Meehl & Rosen (1955), among others.

Table 7

Hit Rates (No./%) Using Discriminant Functions to Predict Group Membership (combined ability/value analysis)

Actual group	Predicted group			Total
	Math-science	Humanities	Other	
Math-science	<i>179/79%</i>	5/2%	43/19%	227/53%
Humanities	37/55%	<i>12/18%</i>	18/27%	67/16%
Other	66/48%	4/3%	<i>68/49%</i>	138/32%
Total	282/65%	21/5%	129/30%	432/100%

Note. Values on the diagonal are "hits" and are in italic type. There are a total of 259 hits, or 60%. For the purpose of classification, prior probabilities (base-rates) of group membership were based on sample probabilities for each group. These base-rates are listed in the "Total" column.

base-rate expectations, ranging from 18% to 79%, resulting in a total classification accuracy of approximately 60%<sup>3</sup>.

Discriminant content and dimensionality. All subsequent results were gleaned from the discriminant analysis in which both ability and value variables were entered as predictors. Detailed results of this discriminant analysis are presented in Table 8. Two statistically significant discriminant functions were yielded, with a Wilks's lambda of .77 indicating that approximately 23% of variance between major groups in this sample was explained by differences in participants ability and value profiles. The first function accounted for 75% of the explainable variance and the second function accounted for the other 25%.

Table 8

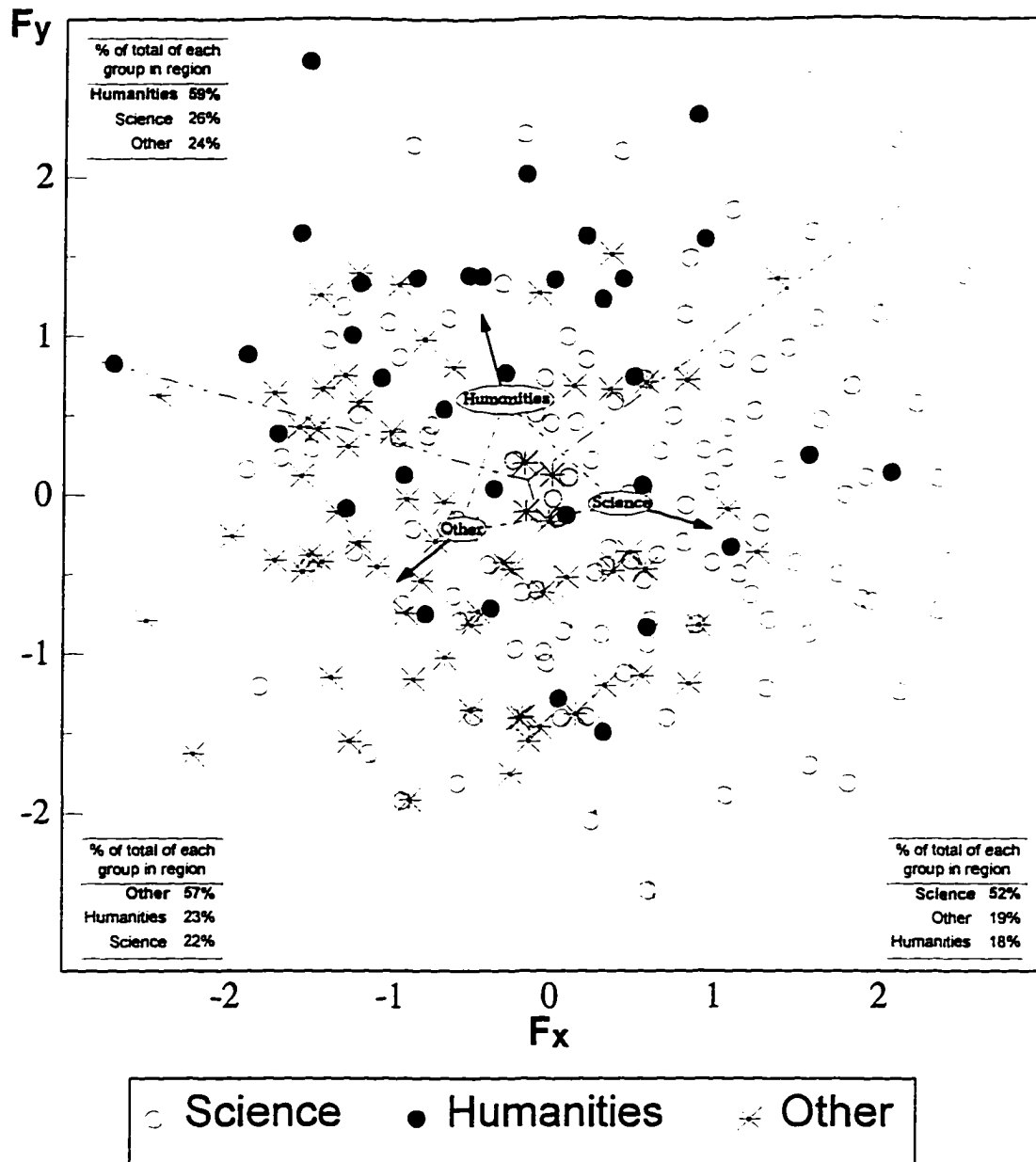
Discriminant Function Results Using All Predictor Variables

Discriminant function	Eigenvalue	% of variance	Canonical correlation	After function removed	Wilks's $\Lambda$	p
				0	.77	<.00005
1	.22	75	.42	1	.93	<.00005
2	.07	25	.26			

To illustrate the amount of group separation achieved by this discriminant analysis, Figure 1 depicts plots of the bivariate group centroids (average discriminant scores assigned to members of each group) and individual participants' bivariate discriminant scores plotted in two-dimensional discriminant space. Each of the three college major groups clearly claimed a unique territory in this space to distinguish it from the other two. For descriptive purposes, the figure was parsed into the three regions roughly defined by the three criterion groupings in this study. An analysis of these regions revealed an impressive degree of accuracy in capturing members that belong in each group, especially as individual bivariate points move toward the outer areas of each region. The percentages of "correctly-placed" participants in these regions (see inset boxes) was similar to the "hit rates" achieved by the discriminant analysis when equal prior probabilities of group membership were assumed (see footnote 3).

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<sup>3</sup> Using the alternative method of classifying individuals based on the assumption of equal prior probabilities (33%) in each group produced the following hit-rates: Math-Science, 57%; Humanities, 54%; Other, 58%. Overall classification accuracy using this method was 57%.



**Figure 1.** Group centroids and individual participants' discriminant scores plotted in two dimensional discriminant space. To simplify the figure, only half of the total sample data is plotted, such that each bivariate point represents an average of two participants' discriminant scores. To aid interpretation, three regions were demarcated by calculating the bivariate mean of the three centroids and drawing lines from this point through the midpoints separating each pair of centroids (distances between centroids are represented by the triangle). The arrows emanating from each centroid are 180° extensions of these dividing lines, representing the direction of maximal separation from both of the other two groups.

The group centroids and structure matrix presented in Table 9 allow for a content evaluation of the two significant discriminant functions. In general, results are consistent with prior hypotheses. Recall that the group centroids represent the association between a group and a function, and that a comparison of centroid values across groups provides a sense of the dimensionality of group differences (Borgen & Seling, 1978). Similarly, the structure matrix depicts correlations between each predictor variable and the discriminant functions. These can be referred to as discriminant loadings and aid in the interpretation of function content (Betz, 1987). The patterns found among group centroids and predictor variables make possible the interpretation of Function 1 as a "Math-Scientific" function and Function 2 as a "Verbal-Humanistic" function. An examination of Function 1 revealed that it separated participants completing Math-Science majors (large positive centroid) from both the Humanities and Other groups (large negative centroids), with higher scores on Theoretical values and Math abilities (high positive correlations), and lower scores on Social and Religious values (high negative correlations) characterizing the Math-Science group. Function 2, on the other hand, separated those completing majors in the Humanities (large positive centroid) from the other two groups (negative centroids), with higher scores on Aesthetic values and Verbal abilities (high positive correlations) characterizing the Humanities group.

Stated differently, when Math abilities and Theoretical values coexisted at increasingly higher levels of intensity, and Social and Religious values coexisted at lower levels, the probability that a participant completed a Math-Science major increased.

Table 9

Group Centroids and Structure Matrix

Group or Variable	Discriminant function	
	1	2
Group	Group centroids	
Math-science majors	.43	-.05
Humanities majors	-.29	.60
Other majors	-.57	-.21
Variable	Structure matrix	
SOV-Theoretical	.87	-.03
SOV-Social	-.60	-.01
SAT-Math	.59	-.12
SOV-Religious	-.56	.03
SOV-Economic	.47	-.29
SOV-Aesthetic	-.13	.81
SAT-Verbal	.07	.56

Conversely, when Aesthetic values and Verbal abilities coexisted at increasingly higher levels, the probability of completing a major in the Humanities increased. The Other group was most strongly associated inversely with Function 1 (high negative centroid). Therefore, it appears that the likelihood that a participant completed a major found in the Other group increased with higher scores on Social and Religious values (high negative correlations with Function 1), and lower scores on Math abilities and Theoretical values (high positive correlation with Function 1) relative to the Math-Science group.



## Discussion

Overall, the predictive accuracy and amount of group separation achieved by this analysis, as well as the existence of theoretically interpretable discriminant functions, lends support for the validity of using above-level ability tests and preference questionnaires with intellectually gifted adolescents to predict later educational outcomes. Perhaps most significantly, the findings support the assertion that preferences provide incremental validity to abilities in the prediction of later educational choices in this population. In addition, the variables that contributed most to predicting the broad criterion groups utilized in this study conformed to hypothesized relationships gleaned from theory and research. Importantly, these predictive results were obtained 10 years after initial assessment, and initial assessment occurred at approximately age 13—a period of life when abilities and preferences are considered to be at an early developmental stage in the general population. This finding substantiates the notion of early crystallization of preferences among the intellectually gifted (see also, Lubinski et al., 1995, 1996; Schmidt et al., 1997) and is sufficient enough to support teaming above-level preference assessment with above-level ability testing when assisting gifted adolescents in educational and early career decision making.

The results are also noteworthy in light of the selection bias toward the mathematically gifted inherent in the SMPY sample. This bias is especially manifest in cohort 1, less so in cohort 2, and relatively little in cohort 3. (Today both math and verbal abilities are used for identifying new participants, and spatial abilities are systematically assessed as part of SMPY's research program; Lubinski & Benbow, 1994). The bias was expressed in the present study through the large relative size of the Math-Science criterion

group in comparison to the other two groups. Given this selection bias, it is notable that the analyses distinguished with significant accuracy between students who followed Math-Science paths and those who chose other academic avenues. The utility of multi-dimensional vocational assessment (Dawis, 1992) was highlighted in this regard, as abilities alone did not predict group membership as well as abilities plus values, substantiating the notion that factors other than ability are critical to useful differentiation of educational and vocational life choices made by the intellectually gifted.

### Theoretical Implications

The results of this study can be discussed in light of the theoretical ideas contributing to prior hypotheses. First and most generally, the results add to a growing number of studies that successfully apply the broad vocational rubric described by the Theory of Work Adjustment to answer questions about the educational and vocational development of the intellectually gifted. The two classes of personal factors stressed most in TWA, abilities and preferences, do indeed represent viable components critical to choosing among competing environments, and the present study suggests that both contribute meaningfully to this pursuit among the intellectually gifted, beyond the individual contributions of either. Although satisfaction and satisfactoriness were not measured directly in this study, their predicted outcome, tenure, was evaluated via the completed college major criterion, which represents an educational outcome requiring four or more years of sustained commitment. Future research among the intellectually gifted can more fully investigate the extent to which the vocational adjustment dimensions of TWA (i.e., satisfactoriness and satisfaction) are

supported by continuing to assess gifted persons throughout the life span in their educational and work environments.

The organizational patterns of abilities and values found in this study affirm the presence of C. P. Snow's (1959) two cultures among the intellectually gifted and suggest that each culture indeed is associated with unique ability and preference patterns that differentiate its members and their approaches to the world from those in the other group. The present findings that the Math ability/Theoretical value combination corresponded to Math-Science environments, and the Verbal ability/Aesthetic value combination corresponded to Humanities environments are in agreement with Ackerman's (1996; Ackerman & Heggestad, 1997) reports of commonly observed ability/preference clusterings in adults, as well as other findings among mature populations (e.g., Kimble, 1984; Humphreys et al., 1993) and intellectually gifted adolescents (Schmidt et al., 1997).

Finally, a brief mention of ties to Holland's theory can be made. As stated previously, instruments such as the Strong that assess Holland's theoretical dimensions overlap significantly with the SOV, at least among the intellectually gifted (see Schmidt et al., 1997, for correlations among scales), therefore allowing inferences about consistencies with Holland's theory to be made from the value dimensions assessed in this study. To the extent that these interest-value relationships are robust, we can comment on the similarities between Holland's hexagonal organization of interests and environments and the organizational patterns found here. In terms of the spatial organization depicted in Figure 1, the Math-Science and Other groups were farthest apart from one another in discriminant space, whereas the Humanities group was in closer proximity to both of these two groups. In

Holland's classification system, Math-Science environments are dominated by Realistic and Investigative interests, contiguous interest domains on Holland's hexagon. By contrast, majors in the Other group, such as business and social science majors, are dominated by Social and Enterprising interests, contiguous interest domains directly opposite--and therefore most dissimilar from--Realistic and Investigative interests on the hexagon. Humanities environments, on the other hand, are best characterized by Holland's Artistic theme, which is adjacent to both the Investigative and Social themes on the hexagon, indicating a closer similarity to both groups that translated in this study into a shorter distance in discriminant space. In general, therefore, the discriminant distances emerging from this study appear also to conform with expectations from Holland's theory.

It can be expected that future research utilizing Holland's interest themes with intellectually gifted samples will produce similar or better predictive results than those obtained here. Data from Schmidt et al. (1997) supporting the validity of the Strong Interest Inventory in predicting ability, personality, and biographical variables among the gifted suggest that Holland's interest themes may indeed be productive in this regard.

#### Applied Implications

The results presented here, coupled with recent research into the reliability and validity of above-level preference measurement among intellectually gifted adolescents (c.f. Lubinski et al., 1995, 1996; Schmidt et al., 1997), provide a foundation firm enough to warrant advising the application of above-level preference assessment by educators and counselors working with intellectually gifted adolescents. This approach has enough construct and predictive validity to justify its use in practice. If intellectually gifted students

are ready to benefit from having this information at earlier ages than their other peers. which it appears they are, then such information can be provided to them at that time so they can begin to make informed choices to construct their learning environments in ways that match personal characteristics and allow for the optimal development of potential (Scarr, 1996). Some general suggestions along these lines, gleaned from the results of the present study, are provided below.

The discriminant function results depicted in Figure 1 reveal some important insights for counselors working with gifted adolescents. Note that as an individual's bivariate point moves farther away from a given group's centroid (especially in the direction of the arrow), the likelihood that the individual is a member of this group increases. In more practical terms, this means that the more intensely focused an individual's ability and preference patterns are, in the direction of the general patterns found in a specific criterion group, the more confident one becomes that they will complete a college major within that group. So, to the degree that a student's scores in the Verbal/Aesthetic ability/preference clustering exceeds other profile scores, suggesting the development of talents in the Humanities may be ventured with greater confidence. To the extent that a student's Math/Theoretical clustering is dominant, on the other hand, he or she might be encouraged to think about Math-Science domains for talent development. To the extent that neither of these clusterings is approximated (but others are, such as a high-Social/low-Theoretical values combination), exploration into other fields (e.g., business, politics) becomes more appropriate. These gradations of confidence must be assessed on a case-by-case basis according to the uniqueness offered by each individual ability and preference profile.

It should be noted that while male and female gifted students' ability and value profiles differ in score intensity across domains of these important variables, gender did not add to prediction of college major grouping in this study because the relative pattern of scores on the dimensions that discriminated best between members of the three groups was the same across genders. Thus, while it is important for educators and counselors to be aware of gender differences that are present among intellectually talented students, the relative patterns delineated above should prove equally useful in assisting both male and female gifted students.

In general, then, counselors can identify relative strengths and weaknesses among their gifted students' profiles in light of what is known about students who chose humanities, math-science, or other domains of study, and then generate hypotheses that can be tested with individual students. This is what careful counselors are likely to do anyway, and this general information may be especially helpful to students at ages when the decisions being made are more general in nature (e.g., what classes to take next semester) than choosing an occupation or career, but are no less critical and have important implications for subsequent educational and career decisions.

#### Limitations and Implications for Future Research

Some limitations of the present study deserve mentioning. First of all, the study was not all-inclusive in its assessment of accepted general ability domains, as spatial ability, a third major marker of general intelligence (Carroll, 1993; Snow & Lohman, 1989), was not assessed among participants in the study sample. It is likely that the inclusion of a spatial ability measure would have further refined prediction of group membership achieved by

abilities alone, especially in the Math-Science group (Austin & Hanisch, 1990; Humphreys et al., 1993; Humphreys & Lubinski, 1996), thereby accounting for more variance in the prediction of completed college major.

The breadth and small number of criterion groups and the use of only one outcome measure are two other limitations that limit the generalizability of results from the present study. Future research could attempt to extend the present approach by examining a larger number of criterion groups and additional educational or vocational outcomes, such as occupational choice.

The final limitation that will be noted is the absence of cross-validation in the present study. Cross-validation of discriminant analysis results with an independent population is highly desirable to obtain unbiased classification estimates (Afifi & Clark, 1990; Betz, 1987; Tatsuoka, 1988), but was not possible with the present sample due to sample size limitations. Therefore, subsequent research should include multiple sample generalization probes of these findings.

Data from future follow-up studies conducted by SMPY will be able to address many of the questions raised above. For instance, 10-year follow-up data for Cohort 4 includes a spatial ability measure, and 20-year follow-up data for Cohorts 1-3 will include participants' occupational choices. Additional interest data will also be collected during these follow-up studies to round-out the assessment of preferences. The results presented here are promising, and future research will help to further delineate the nature of relationships between adolescent ability and preference profiles and educational/vocational planning and adjustment among the intellectually gifted.

### Conclusion

The old adage that intellectually gifted students can be anything they want to be is gradually being put to rest as it becomes more clear that above-level assessment of ability and preference among the gifted provides a reliable and valid means of identifying the breadth of individuality found in gifted populations. Not only is ability intensity important (Benbow, 1992), but so is ability and preference pattern. This study adds to the growing evidence for this conclusion by demonstrating the incremental validity of preferences in respect to abilities among the top 1% of adolescents in intellectual ability. The utility of ability and preference measurement in career planning and adjustment among adult populations has been known for some time (Dawis, 1992, 1996b), and the utility of above-level ability testing among the gifted has been known for over 25 years. With the addition of preferences to their assessment repertoire, educators and counselors of the gifted are now equipped with tools that can be used with students to tease out the most salient features of capacity and motivation--to help them understand in what environments they may achieve excellence rather than above average performance, or find something they feel passionate about vs. something they merely have a strong liking for. Of course, this focus on optimal development (Achter et al., 1997; Lubinski, 1996; Scarr, 1996), appropriate for educational and vocational counseling among the intellectually gifted, is something that the individual differences tradition has always extended to clients within all ability ranges (Tyler, 1992; Williamson, 1965).



### **CHAPTER 3. GENERAL CONCLUSIONS**

#### **General Discussion**

This dissertation began with an integrated review of literature incorporating information from vocational psychology and the study of intellectually gifted persons. The merger of theory and knowledge from these two areas has resulted in a productive line of empirical research into educational and career development issues of the intellectually gifted. The many important outcomes of this merger include the discovery and explication of the unique ability and preference patterns in this population, a growing understanding of how these patterns translate into educational and vocational choices made by the gifted and the levels of success they achieve, and an appreciation for how above-level assessment of abilities and preferences can be practically applied by educators and counselors to assist gifted students in the process of educational and career decision-making. In a scientific sense, these findings have helped advance the knowledge and understanding of educational and vocational development of intellectually gifted persons, and have also served to extend the application of the individual differences tradition in psychology generally, and the PE fit tradition in vocational psychology more specifically. In a more practical sense, these scientific contributions have positively affected education and counseling practice and provided valuable insights into public policy issues as they relate to the intellectually gifted (for a thorough and thoughtful comment on some of these issues, see Benbow & Stanley, 1996).

This dissertation adds an important contribution to the progress noted above, and certainly the future will bring more growth and development. A few thoughts about future research directions are offered in the final section below.

### Recommendations for Future Research

As researchers continue to study the educational and career development of intellectually gifted persons throughout their lifespan, several exciting questions can be explored. Extending the methodology of the present study, investigators might attempt to predict graduate school choices, and both vocational and avocational pursuits of the intellectually gifted. By utilizing Snow's two cultures or some other classification system (e.g., Holland's), these analyses could further delineate the contributions of abilities and preferences to these choices, and continue to evaluate the degree of continuity (Holland, 1996) present throughout the lifespan. Additional variables to explore through future research include the unique roles of spatial abilities and interests in predicting educational and vocational choices and outcomes. Both represent viable personal attributes that have the potential to improve upon the predictive success achieved by the ability and preference dimensions assessed in the present study.

As research with the intellectually gifted continues to evolve, surely the ingenuity of others will produce a steady flow of stimulating research topics, contributing to increased knowledge, better understanding, and improved educational and counseling practices with this special population.

Means and Standard Deviations of Criterion Variables by Completed College Major Group and Sex

	Math-science				Humanities				Other			
	<u>Male (n = 170)</u>		<u>Female (n = 57)</u>		<u>Male (n = 34)</u>		<u>Female (n = 33)</u>		<u>Male (n = 68)</u>		<u>Female (n = 70)</u>	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Abilities												
SAT-M	606	96	543	84	567	83	522	80	565	80	514	71
SAT-V	444	91	475	99	469	94	487	69	437	76	437	69
Values												
Theoretical	49.3	7.2	43.1	8.2	46.6	7.5	38.6	7.0	45.0	6.4	37.1	6.2
Economic	43.4	7.0	36.5	7.3	41.2	6.9	34.4	6.4	40.4	6.3	37.0	5.9
Aesthetic	34.7	7.3	41.1	7.8	36.8	8.4	46.0	8.1	33.2	7.2	39.3	7.2
Social	37.7	6.2	43.7	7.3	39.6	6.8	44.9	9.0	40.7	5.5	46.3	6.6
Political	43.5	6.4	40.0	6.3	42.2	7.8	36.8	6.8	45.1	7.0	39.8	6.7
Religious	31.1	9.8	35.8	9.4	33.9	11.8	39.3	12.3	35.3	8.6	40.3	9.2

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